CHAPTER 15

REFUELING FROM REFUELING SYSTEMS

Section I. Forward Area Refueling Equipment

UNIT-LEVEL REFUELING OPERATIONS

Unit-level refueling operations in theaters of operation are usually carried out by individual aviation units. A lightweight, air-transportable refueling system is used at the unit level. At present, the system authorized to most units that have the refueling aircraft mission in forward areas is the FARE system. This system can be set up by skilled personnel within 15 minutes of delivery to a site.

USE

The FARE system is designed for refueling helicopters in forward areas. It is lightweight and can be flown to the refueling point by helicopter or fixed-wing aircraft. The bulk fuel for the system is usually flown to the site in 500-gallon collapsible drums by utility or cargo helicopters. Chapter 14 describes how these tanks are filled. The FARE system can also use collapsible tanks, tank vehicles, and semitrailers as fuel sources. To do so, the adapters which are included in the system are used.

EQUIPMENT

The FARE system (NSN 4930-00-133-3041) consists of a pumping assembly, filter/separator, hoses, nozzles, grounding equipment, and valves and fittings. The components of the system, packed for transport, and the fire extinguishers that should be used with the system are shown in Figure 15-1, page 15-9, and TM 5-4930-229-12&P.

Pumping Assembly

The pumping assembly includes a 100-GPM gasoline engine-driven centrifugal pump. The pump inlet connection is a 2-inch female fitting, and the outlet is a 2-inch male fitting. The pump-engine assembly and the engine's fuel tank are all housed in a tubular aluminum frame. Refer to TM 5-4320-256-14 for maintenance and operation of the pumping assembly.

Filter/Separator

The 100-GPM filter/separator is used to remove sediment and free water. For more information on the filter/separator, see Chapter 21 or TM 5-4330-217-12.

Discharge Hose and Fittings

The FARE system has two sets of discharge hose, fittings, and nozzles. The T-Kit and Y-Kit are both mounted in a tubular aluminum frame. The equipment in the two sets includes the following:

- Four 50-foot lengths of 2-inch discharge hose.
- Two 2-inch male couplings.
- Two 2-inch butterfly valve assemblies.
- Two 2-inch elbow coupler valves.
- One T-fitting assembly.
- One Y-fitting.
- One 2-inch male to 4-inch female coupling.
- One 2-inch male to 3-inch female coupling.
- Two closed-circuit nozzle assemblies, each with an open-port nozzle adapter. (There are three models of CCR nozzles that can be used with the FARE: 1. Wiggins Model CCN 101/14; 2. Aeroquip Model AE83206R; and 3. Model 125-1000.)
- Two 2-inch male-to-male adapters (NSN 4730-00-887-3824).

- Water detector kit adapter.

Suction Hose and Fittings

Two canvas carrying cases hold the suction hose and their fittings. The equipment in the two sets include the following:

- Twelve 5-foot lengths of 2-inch suction hose.
- Four 5-foot by 5/8-inch grounding rods, each with nozzle hanger and striker.

Other Required Items

Other items of equipment are needed to conduct aircraft refueling operations with a FARE system. These are fire extinguishers and a fuel source.

- Fire extinguishers. Extinguishers are not components of the FARE system. Providing fire extinguishers is a command responsibility. Three fire extinguishers are required for each FARE system used in aircraft refueling--one to be within reach of the pump operator and one for use at each nozzle. Fire extinguishers acceptable for use are 20-pound dry-powder (NSN 4210-00-257-5343) and the 15-pound CO_2 (NSN 4210-00-202-7858).

- Fuel source. No fuel source is provided as a component of the FARE system. Generally, 500-gallon collapsible drums are used because they can be airlifted full to the fuel point. But the FARE system can also be adapted to use larger fuel reservoirs or the ERFS tanks for aircraft to aircraft refueling. Collapsible drums and tanks are issued separately. The number of drums or tanks, as well as the type of fuel to be used, is determined by the number and type of aircraft the FARE point is to support.

LOCATION

The operations and training officer (S3) of the aviation battalion or the operations officer of the aviation company plans the unit operations. As part of these plans, he chooses the general area for a refueling point and specifies the amount and type of refueling support that will be needed. The specific site is selected either by the company operations officer, a pathfinder or a pathfinder team. If the operations officer selects the site, he should physically check the area. He must choose a site that has enough open ground for the aircraft to land and lift off safely. The site must be flat or have only a slight slope. He then informs the personnel who are to set up the system where and when to establish the refueling point, how much of what type of fuel to take, and the type of setup required. If a pathfinder selects the specific sight, he enters the general area on foot or by vehicle, aircraft, or parachute to survey the possible locations. He has sufficient training to select a site that meets aviation requirements. He radios coordinates of the site to the units that will setup and use the site. He will also select the specific location for the refueling system. Operating personnel will choose the specific location at the site that is best for laying out the equipment if a pathfinder does not select the site.

SITE LAYOUT

When the layout of a FARE system is being planned, five factors must be considered in addition to METT-T. These are described below.

Spacing Between Aircraft

Usually OH-6, OH-58, AH-1, UH-60, AH-64, or UH-1 helicopters are refueled at a forward refueling point. There must be 100 feet of space between these aircraft (rotor center to rotor center) (as shown in Figure 15-2, page 15-10). In an emergency, a CH-47 or CH-54 may have to be refueled. Do it with the same layout but only if no other helicopter is at the site.

Wind Direction

Lay out the FARE system so that the helicopter can land, refuel, and take off into a direct head wind or a left or right quartering head wind (Figure 15-2, page 15-10). If it is impossible to lay out the system this way, lay it out so that the aircraft will land, refuel, and take off in a crosswind. Avoid laying out the system so that helicopters will have to land or take off downwind. Such a maneuver is very dangerous because it is difficult to control a helicopter when its tail is to the wind on landing or takeoff.

Vapor Collection

By laying out the site at right angles to the wind for helicopter landing and takeoff, the wind will carry the fuel vapors away from the site. This is the best layout. Remember that fuel vapors are heavier than air and that they will collect in a valley or hollow. If the site slopes, lay out the equipment on the higher ground.

Drainage

Do not lay out equipment in a place where a spill will drain into a stream, river, wetland, seashore, lake, or other environmentally sensitive area. A spill could contaminate the water and create an unsuspected fire hazard downstream of the site. Choose a part of the site that is firm enough to support the weight of the aircraft and the fuel drums.

Camouflage

Camouflage is the only protection at a FARE point in a combat zone. Site features will be depended upon because airlifting in camouflage materials is not practical. When possible, put the pump, filter/separator, and fuel drums in woods or brush, along a hedgerow, or in positions where natural shadows will disguise the shadow patterns of the equipment. It may be possible to conceal most of the hose in woods, with nozzles hung on hangers at the edge of the tree line. Deep grass can be bent over the hoses to help conceal them. When spray paint is available, use earth and grass tones to dull and conceal couplings and fittings. Heaped dirt or large rocks can be used alongside of the hoses (never on top) to break up the characteristic straight shadows. However, remember that shadow patterns change during the day. Move equipment, if necessary, to use these changing patterns.

SITE PREPARATION

All sticks, stones, and debris should be cleared from the area. They can be sucked up and thrown out by rotor wash. Also clear the immediate refueling area, paths of approach, and hover lanes. To prevent fires, clear dry grass, leaves, and brush away from the pumping assembly. In some cases, engineer personnel prepare the site. This occurs when the site must be bulldozed (on a mountain) or if the site must be treated with dust suppressant (in a sandy desert). In such cases, the company or battalion operations officer must arrange for site preparation, in advance, with the engineers.

EQUIPMENT LAYOUT

Lay out the FARE system in the way that is best for the specific situation. Tailor the layout to avoid obstacles, to take advantage of terrain features, to achieve maximum dispersion, and to operate within a restricted amount of space. The only mandatory feature of the FARE system layout is the spacing between aircraft. The layout directions that follow use all the hose. Figure 15-3, page 15-11, shows the FARE system laid out with all component hose. Regardless of the layout that fits the situation, follow one basic rule when laying out equipment: Never take a dust cap or plug off until ready to couple the next piece of equipment. Follow the same rule, in reverse, when uncoupling. Always position spill containers before uncoupling. Uncouple, drain, then cap or plug immediately. Couple removed caps and plugs together to keep them clean. Keep dirt out of the system. Use the butterfly valves to shut off the flow from one or both drums, to switch from one to another, or to shut down the system. Thus, the butterfly valves serve as an emergency shutoff, providing quick positive shutoff. Remember the lives of the aircrews and the troops they are supporting depend on the quality of the fuel pumped into the aircraft. Lay out the FARE system using the procedures described below.

- Position Pump and Filter/Separator**.** Place the pumping assembly on a cleared level spot. Have the inlet port facing the place where the collapsible drums will be. (In this system, all inlet ports are female and all outlet ports are male.) Connect the female end of a 5-foot length of suction hose to the pump outlet. Connect another length of suction hose to the first suction hose. Connect the male end of the second hose length to the inlet port of the filter/separator.

- Ground Pump and Filter/Separator**.** Drive one ground rod into the ground between the pump and filter/separator. For the depth required to ensure a proper ground, see Chapter 2. Attach the pump ground cable clip and the filter/separator grounding clip to the grounding rod.

Connect to Two 500-Gallon Drum

To lay out the system as shown in Figures 15-2, page 15-10, and 15-3, page 15-11, do the following:

- Couple the male end of a 5-foot length of suction hose to the inlet port of the pump and couple a T-fitting to the female end of the suction hose.
- Couple a butterfly valve to each inlet of the T-fitting. The arrows on the valves should point in the direction of the fuel flow (toward the pump). The butterfly valves are used to shut off the flow from one or both drums, to switch from one to another, or to shut down the system. Thus, the butterfly valves serve as an emergency shutoff, providing quick positive shutoff. A butterfly valve is open when its handle is parallel to the centerline of the valve and closed when its handle is perpendicular to the centerline.
- Couple four 5-foot lengths of suction hose to each butterfly valve, and roll fuel drums into position near the ends of the suction hoses.
- Connect an elbow coupling to each drum's outlet port.
- Use a male-to-male adapter fitting to connect the two female fittings at each drum. (There is a female end on the suction hose and a female end on the drum elbow coupler.)

Connect Other Supply Sources

If hooking the FARE system to a bulk fuel supply, such as a collapsible tank, put a butterfly valve in at the connection to the suction line and use the 2- to 4-inch coupling adapter. The valve will control the flow of fuel to the FARE system.

Assemble Discharge Hose

The discharge hose can be assembled in several different ways, but any arrangement must provide for enough distance between helicopters. A typical layout is shown in Figure 15-2, page 15-10. A schematic drawing of this layout is provided in Figure 15-3, page 15-11. To assemble the hose for this layout, connect the female coupling at the end of a 5-foot length of suction hose to the outlet port of the filter/separator and the male end to the female inlet of the Y-fitting. Connect two 50-foot lengths of discharge hose to one outlet of the Y-fitting and two 50-foot lengths to the other outlet.

Assemble Dispensing Points

When the discharge hose is laid out, walk down it about 10 feet toward the Y-fitting. Drive a ground rod into the ground. (For the depth required to ensure proper ground, refer to Chapter 2.) Go back to the end of the hose, attach the CCR nozzle, carry the nozzle back to the grounding rod, and hang the nozzle on the nozzle hanger. Attach the clamp of the grounding cable to the ground rod. If aircraft that are not equipped for closed-circuit refueling are expected, hang the open-port nozzle adapter on the nozzle hanger too. Loop the last 10 feet of hose back on itself as shown in Figure 15-2; page 15-10, no hose should lie beyond the nozzle hanger. Pace off the distance from the ground rod to a point 10 feet from the outer end of the second 50-foot hose on the other arm of the Y-fitting. If it is less than 100 feet, move the hose farther apart and set up the other dispensing point the same way.

Position Fire Extinguishers

Place one fire extinguisher at the pump and one by each combination ground rod/nozzle hanger. They must be in place at all times. Finally, go back and check the whole system to make sure all the fittings and couplings are locked tight. Make sure all four ground cables (from the pump, filter/separator, and one from each nozzle) are securely clipped to the three ground rods (one for the pump and filter/separator, and one for each nozzle). The completed system should look like the system in Figures 15-2, page 15-10, and 15-3, page 15-11.

PREPARATION FOR OPERATION

Before starting up the system, fill the pump engine gas tank with fuel or run a supply line from a fuel source (tank, can, or drum) to the fuel selector valve on the pump frame. Check the oil level in the pump engine crankcase. Then start up the system. If no aircraft are expected until a prearranged time, turn the system off after this initial startup and check. Follow procedures described below to ensure the equipment will be operational when needed.

• Priming the Pump**.** The pump can be primed by gravity or manually. Always prime the pump with the same type of fuel that will be pumped into the aircraft. Gravity prime and manual prime are described in the STP 10-77F15-SM-TG.

• Priming the Filter/Separator**.** If the fuel level in the supply source is above the filter/separator, the filter/separator will fill by gravity flow. If gravity flow primes the pump but does not fill the filter/separator, start the pump. Turn on the pump engine to idle speed. Close the filter/separator air vent as soon as fuel appears in the sight glass and let the pump fill the filter/separator. Check the pressure differential indicator of the filter/separator to ensure that the filter elements are operating properly.

• Checking for Full Prime**.** The pump should obtain a full prime (maximum suction lift) in about four minutes. If full flow is not reached in five minutes, stop the pump. Try to find the problem. Do not run the pump more than five minutes without a flow. This will cause the pump to overheat and damage the pump shaft seal. If the pump has not obtained a full prime follow troubleshooting procedures outlined in the STP and TM 5-4320-256-14

• Inspecting Hose**.** Inspect all hose daily before use. Follow the steps described below.

••Check hose covering. If any part of a hose length shows signs of blistering, saturation, or nicks and cuts that expose a significant amount of reinforcing material, remove that length of hose from service. Hose should not be removed from service if nicks or cuts penetrate only the outer surface, unless the rubber in the immediate area of the nick or cut is loose. Usable parts of the hose should be salvaged and recoupled. If a length of discharge hose is removed, remember that the layout must change to allow enough space between aircraft.

••Check the couplings. Look for coupling slippage. Coupling slippage usually appears first as a misalignment of the hose and coupling or as a scored or freshly exposed part of the hose where the slippage has occurred. Look for signs of leakage at the coupling. If a coupling is slipping or leaking, remove that length of hose from service. Salvage and recouple hose.

••Check the hose within 12 inches of the couplings. Check the hose closest to the coupling with particular care because most hose failures occur in this area. Check all the way around the hose, pressing lightly and feeling for soft spots. If weak or soft spots are found, remove the hose from service. Salvage and recouple hose.

••Test the hose. Test the hose at normal operating pressure by running the pump with the nozzle closed. Look for abnormal twisting or ballooning . Twisting and ballooning indicate that the hose carcass is weakening, so remove the hose from service immediately. Salvage and recouple.

••Check the nozzle screens. Remove the nozzle screens, and check their contents for particles of hose lining. Particles of rubber left in new hose from the manufacturing process may appear during the first week of use. If such particles appear more than twice during the first week or appear thereafter, remove the length of hose from service immediately because it is deteriorating. Also check the screens for dirt and for other particles that may show that the filter/separator has failed. Report any such indications to your supervisor. Clean and replace the nozzle screens.

Sampling

As soon as the system is full of fuel, draw a sample from each nozzle. Check the samples visually for sediment and with the Aqua-Glo test for water contamination. If dirt is visible in the samples, it may show that dirt got in the couplings while the system was being laid out. Flush out the fuel in the discharge lines into a suitable container. When moving to the refueling point, carry an extra drum to contain this fuel. After flushing the lines, take another sample from each nozzle. If the fuel does not pass the second check, do not use it. Notify your supervisor immediately.

SEQUENCE OF OPERATIONS

The FARE system should be primed and ready for operations as soon as it is laid out and the fuel has been sampled. The pump should be started and idling before the first aircraft arrives. There should be at least three people, besides the air traffic controller or pathfinder, present during FARE point operations--one to tend the pump and one to tend each of the two nozzles. (A member of the crew of the aircraft being refueled can operate the nozzle fire extinguisher.) However, aircrew members must be properly trained and able to handle the refueling of

their own aircraft if the need arises. All three of the personnel should hold MOS 77F. The sequence of actions in refueling is vital to the safety of the operation. This sequence is described below.

Land Aircraft

The ground guide directs approaching aircraft and tells the pilot where to land. If necessary, guide the aircraft into final position. (Use the marshaling signals discussed in Chapter 2.) Check to see that armaments aboard the aircraft have been set on SAFE.

Deplane Crew and Passengers

Only the pilot may remain in the aircraft during refueling. Passengers should go to the passenger marshaling area. If required, a crew member may assist with the refueling by manning the fire extinguisher.

Position Fire Extinguisher

Carry the fire extinguisher from its position by the ground rod to the side of the aircraft by the fill port.

Turn Off Radios

All radios must be turned off for refueling except for the radio used to monitor air traffic control. The pilot must not transmit while actual refueling is taking place.

Ground and Bond the Nozzle to the Aircraft

Either insert the nozzle bond plug into the bond plug receiver on the aircraft or attach the connector clip to a bare metal part of the aircraft. Usually the clip is attached to the skid structure of helicopters; it should never be attached to the radio antenna or to a propeller. When the CCR nozzle is used, it is grounded to the ground rod. Connecting the bonding wire grounds the aircraft and bonds the nozzle to the aircraft.

Remove Dust Cap

After bonding the nozzle, remove the dust cap from the nozzle and then remove the plug from the aircraft fill port. Never put a dust cap on the ground. This could get dirt and dust in the fuel system.

Refuel

During refueling, the pump operator has one set of duties and the nozzle operator has another. These are described below.

- Pump operator. Watch the refueling operation. Maintain visual contact with the nozzle operator. When aircraft are being refueled, run the pump engine at full throttle. When flow stops at both nozzles, cut the speed back to idle. If other aircraft are waiting for fuel or are in sight, let the engine idle. If not, shut down the engine. (The pump engine can idle for a long time without damage, but idling unnecessarily cuts down on the serviceable life of both the pump and the engine.) Watch the 500-gallon drum that fuel is coming from so that a change can be made when it is getting low.

- Nozzle operator. The nozzle operator has different duties depending on which type of refueling is taking place. The duties are described below.

CAUTION

The nozzle operator must maintain physical contact with the nozzle at all times while refueling.

- - Closed-Circuit Refueling. Insert the CCR nozzle into the receiver (fill port) mounted on the aircraft. If the CCR nozzle and port will not mate, look for dirt in the fill port. Wipe out the port with a clean rag, wipe off the nozzle, and lock the parts together. Pull back on the control handle latch, and then push the flow control handle up and toward the aircraft into the FLOW position. If the tank is to be filled completely, watch the back of the nozzle. When flow stops automatically, a red indicator will pop out on the back of the nozzle. If the tank is not

going to be filled completely, watch for the pilot to signal when to stop flow. When he signals or the red indicator pops out, pull the flow control handle back toward the hose into the NO-FLOW position.

••Open-port refueling. Take the dust caps off the front of the CCR nozzle and the back of the open-port nozzle adapter. Lock the adapter into the CCR nozzle before bonding the nozzle to the aircraft and removing the nozzle dust cap and the fill port cap or plug. Pull back on the control handle latch. Put the nozzle adapter deep into the fill port. Push the CCR nozzle flow control handle up toward the aircraft into the FLOW position, and slowly squeeze the trigger of the open-port nozzle to let the flow start. Watch the pilot for a signal if the tank is not going to be filled completely; watch the fill port if the tank is to be filled completely. When the tank gets close to full, let up on the trigger and finish filling slowly. Release the trigger, and pull the CCR nozzle flow control handle back to the NO-FLOW position (back toward the hose). Drain remaining fuel out of the nozzle before taking it out of the fill port.

Replace Caps and Plugs

Replace the plug of the aircraft fill port. Then recap the nozzle.

Remove Nozzle Bond

Unplug the nozzle bonding plug or release the connector clip Carry the nozzle back to its hanger; do not lay it on the ground or drag it across the ground.

Remove Fire Extinguisher

Take the fire extinguisher back to its position by the ground rod.

Board Crew and Passengers

Have the members of the crew and passengers reboard the aircraft.

Direct Aircraft Lift-Off

On direction from the ground guide, have the aircraft lift off.

Turn Off Pump

If no other aircraft are in sight or expected shortly, turn off the pump. Although the pump can idle for long periods, unnecessary idling cuts down on its serviceable life.

Change Fuel Drums

If 500-gallon drums are used as the fuel source, the drums may need to be changed frequently. If the suction manifold is used properly, a continuous flow of fuel can be kept while drums are changed. It is hard for even an experienced soldier to tell when a 500-gallon collapsible drum is empty because the drum is a closed, unvented container. When the drum begins to draw together and has sharp, folds (as shown in Figure 15-4, page 15-11), open the elbow coupling valve to the other full container. The pump engine's speed will increase and will vibrate when the flow from the first drum gets low. When this occurs, open the butterfly valve to the full drum. When the pump starts to draw fuel from the full drum and is pumping at full capacity, the engine speed will return to normal and vibration will stop. Close the elbow coupling valve to the empty drum. Allow enough time for the system to fill with fuel from the fresh drum. If the fuel was not tested before delivery, take a sample from each nozzle for inspection. If the fuel passes visual inspection, continue operations; if it fails the visual check, radio for instructions. Do not use fuel that has not passed inspection. After doing the visual check, unlatch and remove the elbow valve coupler from the empty drum and roll a full one into its place. Latch the suction manifold to the fresh drum by coupling the elbow valve coupler to the drum adapter.

DISASSEMBLING PROCEDURES

Three soldiers are needed to disassemble and move the FARE system. Before it can be moved, the fuel must be drained. The procedures for disassembling and moving the system are described below.

- Step 1. Stop the pump engine.
- Step 2. Close the elbow coupling.

- Step 3. Place a suitable container under the connection at the outlet of the filter/separator. Disconnect the outlet coupling and put the end of the discharge hose into the container.
- Step 4. Open the filter/separator air vent. Drain the fuel from the filter/separator into the container. Plug and cap the filter/separator inlet and outlet. Close the air vent and drain the valves.
- Step 5. Lift the nozzle and nozzle end of the hose. Disconnect the nozzle. Plug the nozzle inlet and set it aside. While another soldier holds the open end of the hose up, walk the fuel in the hose back toward the Y-fitting. (Lift the hose as you walk, or lay it over your shoulder, to force the fuel to drain into the container.) When the Y-fitting is reached, lift it. Holding the Y-fitting up, disconnect the drained hose. Cap the Y-outlet. Go back out the same section of the hoseline, and disconnect the coupling between the two 50-foot lengths. Roll one length of hose while another soldier rolls the other. To roll the hose, cap the male (outer) end and use the capped end as a reel to roll the hose on as shown in Figure 15-5, page 15-12. When the hose length is rolled, plug the female end.
- Step 6. Repeat step 5, working from the other nozzle back to the Y-fitting.
- Step 7. Lift the Y-fitting to drain the remaining fuel from it and from the 5-foot length of suction hose into the container. Disconnect and plug the Y-inlet, and cap and plug the length of suction hose.
- Step 8. Move the container of drained fuel over to the pump. Drain the pump casing and remaining lengths of suction hose into the container. Cap and plug the pump inlet and outlet. Close the container of drained fuel. (This fuel may not be used to fuel aircraft until it has been sampled, tested, and found to be on specification.)
- Step 9. Stow each component in the space provided for it in a frame or canvas container. Place the fire extinguishers for the nozzles and pump with the packaged components of the system. Remove the ground rods and place them in the suction hose containers.
- Step 10. Move the system components, collapsible drums, and fire extinguishers to the next site. They may be moved by helicopter or cargo vehicle.

ADVANCED AVIATION FORWARD AREA REFUELING SYSTEM

The AAFARS will eventually replace the FARE system. The development of the AAFARS results from a need to decrease the refueling time for the aviation company and to field a more environmentally safe system. The AAFARS is a four-point refueling system that provides a minimum of 55 GPM at each refueling point simultaneously. Each refueling point is separated by a distance of 100 feet. The system will be assembled using commercial components including a pumping system, filtration system, lightweight hoses equipped with unisex dry-break couplings, and three types of refueling nozzles. The primary source of fuel supply will be the 500-gallon collapsible drum, although the system will be compatible with other fuel sources as is the FARE. The key function of the AAFARS will be to simultaneously refuel four helicopters in tactical locations using the center point refueling (D-1), CCR, or open-port nozzles. The system will be able to interface with existing U.S. Army, Air Force, Navy, and Marine Corps aircraft and fuel sources as well as having interoperability with NATO and other allied nation's refueling equipment.

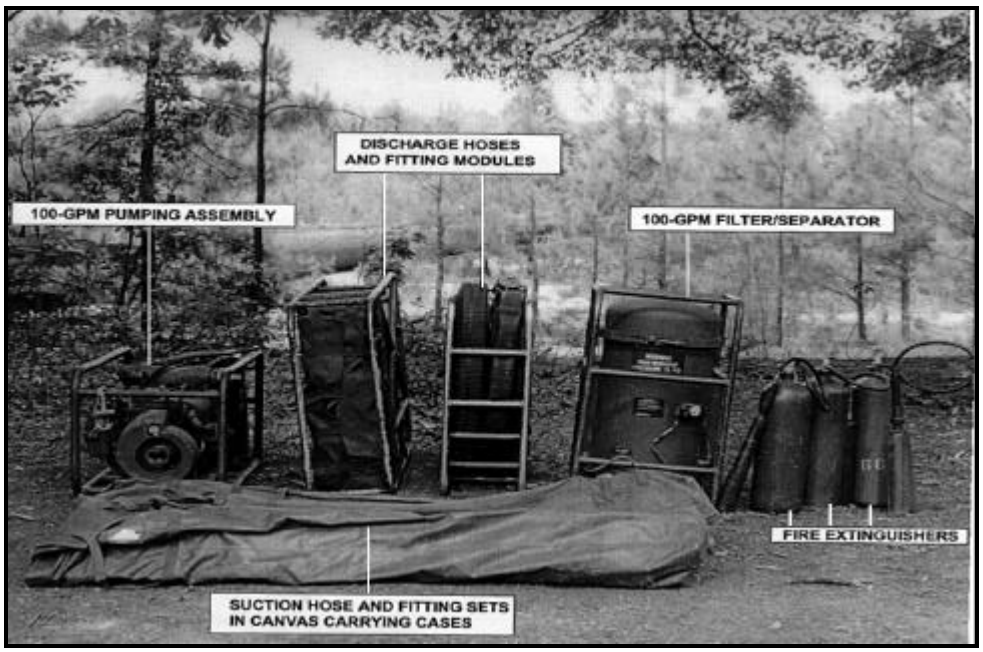


Figure 15-1. FARE system components packed for transport

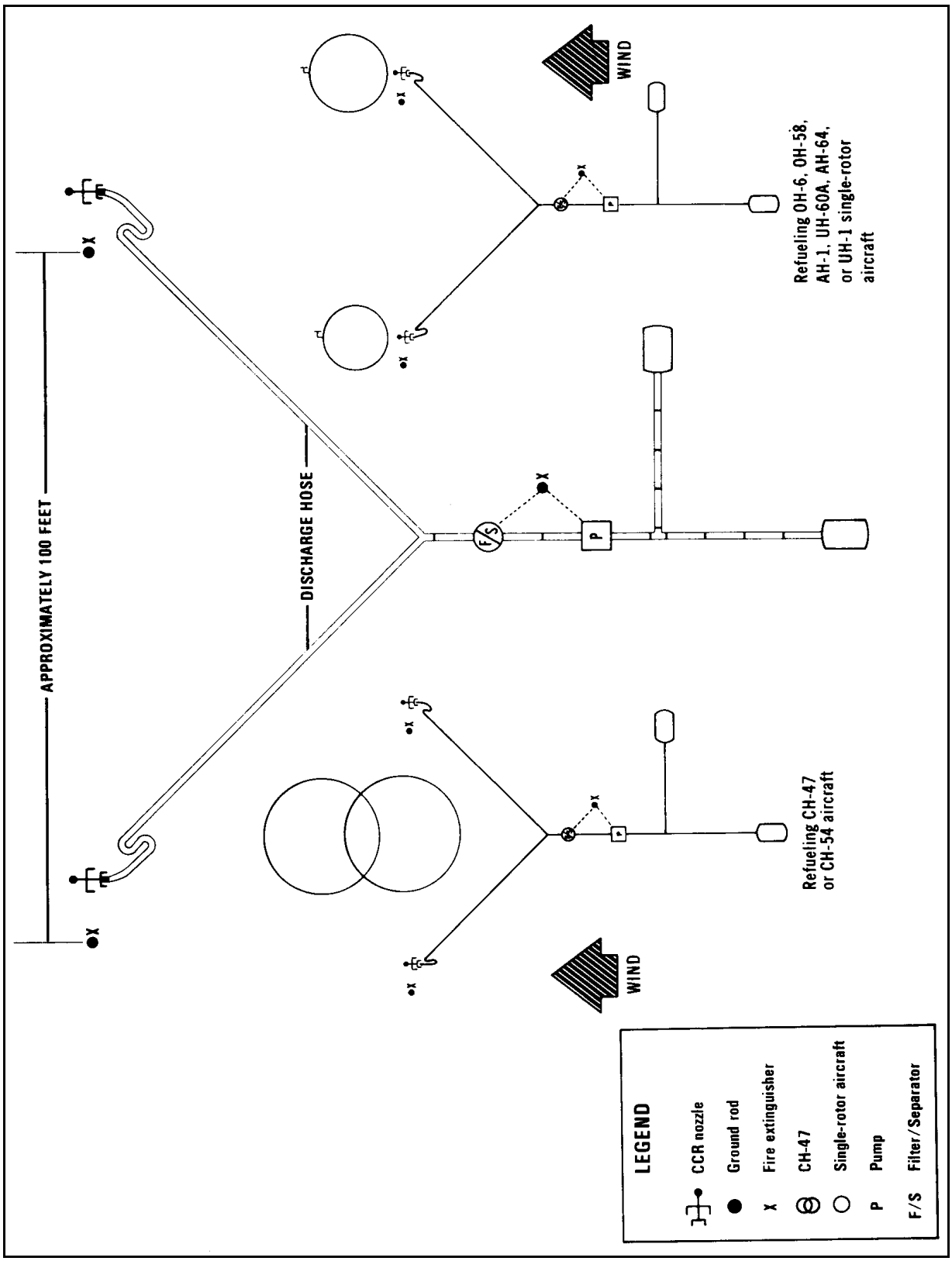


Figure 15-2. Typical layout of FARE system

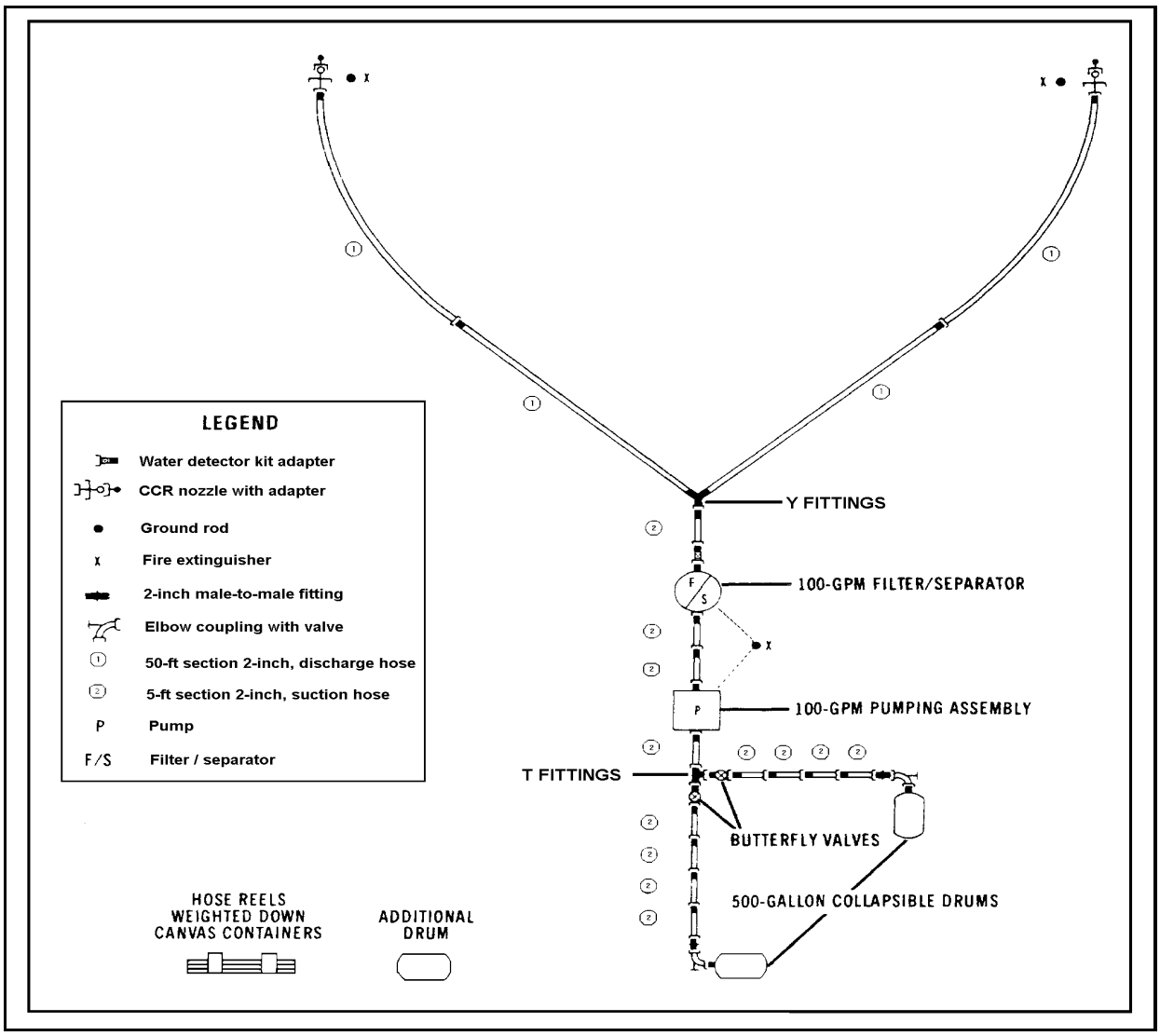


Figure 15-3. Schematic drawing of FARE system

Figure 15-4. Empty 500-gallon collapsible drum

Figure 15-5. FARE discharge hose rolled for packing

Section II. Temporary and Semipermanent Refueling Systems

CHARACTERISTICS

When demand for refueling at a specific location exceeds the capabilities of the FARE system or when there are not enough FARE systems to meet the demand, construction of a temporary or semipermanent system is necessary. Such a system is assembled from components used in the fuel system supply point. A system of this type has greater tank capacity, pump capacity, and flow rates than a FARE system. These factors may justify the establishment of the system on the basis of economy. A temporary system takes hours instead of minutes to set up and uses larger equipment. It is not as mobile as a FARE system. It covers a larger area, so it is more difficult to camouflage and is more vulnerable to enemy attack. Light construction equipment may be needed to level landing pads or prepare the berms around the collapsible tanks. Because all these characteristics make the system unsuitable for forward areas, this system type is usually not set up ahead of the division rear area. Use of this system forward of the brigade rear area is not recommended.

USE

A temporary refueling system is used to refuel aircraft in the field, usually in a rear area. The length of time that a temporary refueling point is used depends on the tactical situation. The point may be used for a few days, a few months, or even years. It may be that the refueling point is temporary only in the sense that it is not a permanent airfield with a built-in, underground refueling system.

EQUIPMENT

Standard petroleum-handling equipment, the FSSP components, and the CCR nozzle with open-port adapter are used to assemble a temporary refueling system. The amount of equipment required depends on the planned use of the system--the type and number of aircraft to be serviced at the point. The basic equipment needed to set up a temporary refueling system to refuel aircraft are described below.

Fuel Reservoir

Ordinarily, a 3,000-, 10,000-, 20,000-, or 50,000-gallon collapsible tank is used to provide bulk fuel storage. Any of these tanks can be moved to a field site easily. One or more of these tanks may be used to meet the required operating capability of the system.

Pumping Assembly

The 350-GPM pumping assembly is used for temporary refueling systems. It can be moved to the site by helicopter, fixed wing cargo aircraft, truck, or trailer. Although the assembly is trailer-mounted and it may be towed short distances by a vehicle, it should not be towed across country or in convoy moves. The pumping assembly includes the valves, gages, and controls needed to operate it. It is equipped with a ground rod and cable. The main components of the pumping assembly are the pump and pump engine. Chapter 20 gives more information on pumps.

- Pump**.** The self-priming, centrifugal pump is rated at 350 GPM at 80 PSI (275 feet of head rated on MOGAS). It has two inlet ports and two outlet ports. Gate valves control these ports. Suction and discharge pressure gages are mounted on the instrument panel.

- Engine**.** Two types of engines are used to power the pump-gasoline and diesel. The gasoline engine is a 4-cylinder, air-cooled engine. The diesel engine is a 3-cylinder, air-cooled engine. The engines have gages and starter switches mounted on their instrument panels.

Filter\separator

The 350-GPM filter/separator is used with the 350-GPM pump. This filter/separator is designed for a flow rate of 350 GPM and a top working pressure of 150 PSI. See Chapter 21 for more information.

Other Components

The number and type of other components required to complete the refueling system (hoses, valves, reducers, nozzles, and fittings) and the way in which these components are assembled are determined by the desired size of the system and the type of aircraft to be serviced

LOCATION

The aviation commander who determines that a temporary refueling point is required also specifies its general location. He delegates selection of the specific site to subordinates. Because a large, temporary refueling point is a valuable target for the enemy and cannot be displaced as quickly as a small FARE point, a temporary system is usually set up in a secure area rather than in the forward combat zone. The selected area must provide enough open space to allow for safe landing and takeoff of aircraft; the land must be relatively level and well drained.

SITE LAYOUT

When planning the layout of a refueling point, your first consideration is to design the facility to accommodate the number and type of aircraft that the refueling point will be required to handle. Other factors to consider are the required spacing between aircraft, prevailing wind direction, vapor collection, drainage, camouflage, and choice of a passenger marshaling area.

Spacing Between Aircraft

The spacing between aircraft depends on the type of aircraft. It depends on two features of the aircraft. These are the dimensions of the fuselage and the size of the circular pattern created by the rotor blades. The spacing reduces the possibility of collisions and prevents one helicopter from being overturned by another. Table 15-1, page 15-14, shows the MINIMUM spacing to be used between aircraft during refueling.

Table 15-1. Minimum spacing required between aircraft during refueling

AIRCRAFT	POSITION	MINIMUM ROTOR-HUB TO ROTOR-HUB
CH-47	SIDE BY SIDE	180 FEET
	NOSE TO TAIL	140 FEET
UH-60		100 FEET
AH-64		100 FEET
OH-6		100 FEET
OH-58		100 FEET
AH-1		100 FEET
UH-1		100 FEET

- Small helicopters**.** Use the same layout to fuel all of the small Army helicopters. The fueling nozzles must be placed so that there is a 100-foot space between nozzles. Figure 15-6, page 15-17, shows a six-nozzle layout for small helicopters (OH-6, OH-58, AH-1, and UH-1). Layouts for five-, four-, three-, and two-nozzle systems for these aircraft are shown in Figure 15-7, page 15-18. These layouts provide 100 feet between nozzles which is adequate spacing for rapid refueling.

- CH-47**.** Setup a separate refueling point for CH-47 helicopters if they are refueled at the point. There are two reasons for this. First, enough space must be allowed between a CH-47 and any other helicopters so that the rotor wash from the CH-47 will not turn the other helicopter over. Second, a CH-47 is refueled from both sides, so a separate refueling system lets both sides be refueled at the same time. This decreases ground time. The recommended layout for a CH-47 refueling point is shown in Figure 15-8, page 15-15-20. Lay out the CH-47 point at a separate site or on the same site as the refueling point for the small helicopters. If both points are laid out on one site, allow 200 feet between the last nozzle of one system and the first nozzle of the other system. For CH-47 helicopters to land side by side, the recommended rotor hub spacing is 200 feet and the minimum is 180 feet. When landing nose to tail, the recommended distance is 160 feet and the minimum is 140 feet. The recommended layout provides adequate spacing for CH-47 helicopters regardless of the direction of the landing. If in an emergency or unusual situation, a CH-47 must be refueled at a point laid out for the small helicopters. Have the CH-47 land some distance from the refueling system and taxi in. Have the CH-47 taxi to the end nozzle. Do not allow any other helicopters to use or approach the adjoining nozzle until the CH-47 lifts off. When refueling is complete, have the CH-47 taxi away from the refueling system and lift off from a designated point some distance away from the system. If a CH-47 is refueled at a two-nozzle point, have it land between the two nozzles and do not allow other aircraft to land at the point until the CH-47 has cleared the area. The CH-47C/D has a D-1, single-point refueling system. When the aircraft is equipped in this way, it is refueled in the same manner as the CH-54.

NOTE: The CH-54 poses the same rotor wash problems to small helicopters as the CH-47 does. The D-1 nozzle is use for the CH-54 and CH-47C/D.

- UH-60**.** The UH-60 is equipped with CCR and D-1 receivers. When the D-1 nozzle is available, it should be used. Otherwise, the CCR nozzle is used for refueling the UH-60. When neither CCR or D-1 nozzle is available, the local commander may authorize open-port refueling. When servicing UH-60 helicopters, position them so that the space from rotor hub to rotor hub is 125 feet (recommended). The minimum spacing for these aircraft is 100 feet. See Table 15-1, page 15-14.

Wind Direction

In an area that has a prevailing wind pattern, lay out the refueling system across the wind (at a right angle to the wind) so that helicopters can land, refuel, and take off into the wind. Because this arrangement is not always possible, the recommended layout provides sufficient distance between nozzles to allow aircraft to land into the wind regardless of wind direction. Figure 15-9, page 15-21, shows how the recommended layout can be used under various wind conditions. Similar approaches and landing directions apply to CH-47 helicopters.

Vapor Collection

Another advantage of a crosswind layout is that the wind will carry fuel vapors away from, rather than across, the refueling point. Because fuel vapors are heavier than air, they will flow downhill. For this reason, lay out the refueling point out on the higher portion of a sloped site and not in a hollow or a valley.

Drainage

Position the refueling point on a part of the site that is firm. Do not lay out equipment in a place where a spill will drain into a stream, river, wetland, seashore, lake, or other environmentally sensitive area. It must be firm and well drained enough to support the weight of the aircraft and refueling equipment.

Camouflage

The extent and type of camouflage required depend on the tactical situation. If camouflage is intended primarily to disguise the refueling point from enemy aircraft, the main concern should be the equipment shadow patterns and straight lines of the hose manifold. When possible, place the pump, filter/separator, and fuel tanks in woods or brush, along a hedgerow, or in positions where natural shadows will disguise the shadow patterns of the equipment. Use camouflage nets and support systems to distort shape and conceal the equipment. Ensure camouflage is staked down securely to prevent being torn loose by rotor wash. Use natural terrain contours and vegetation to help break up the straight lines of the hoses. Use camouflage nets to cover parts of the hoselines that are not close to the nozzles or landing areas. One method of breaking up the straight lines of hoselines is to cut branches, stick them into the earth under the hose that is not close to the nozzles, and weigh them down with the hose. Where grass or other vegetation is deep, bend it over the hoseline to conceal the hose from aerial observation.

Passenger Area

In laying out the site, set aside and mark off space for a passenger marshaling area. The passenger marshaling area should be at least 50 feet from the nearest nozzle.

SITE PREPARATION

How much preparation is required will depend on the intended use of the temporary refueling point. The commander who decides to set up the temporary refueling point determines how much preparation is required. If engineer support is required for ground leveling, dust-suppressant treatment, berm construction, or other site development, the same commander requests the support. The tactical situation, particularly air superiority and site vulnerability, is a major factor in determining the amount of site preparation required at the site.

EQUIPMENT LAYOUT

Figures 15-6 through 15-12, pages 15-17 through 15-24, are guides to laying out equipment systems. Figure 15-10, page 15-22, shows the layout for the refueling system assembly of a six-nozzle system designed to service OH-6, OH-58, AH-1, UH-60, AH-64, and UH-1 helicopters. Figure 15-8, page 15-20, shows a recommended layout for the refueling system of CH-47 helicopters. Figure 15-12, page 15-24, is a detailed drawing of the layout for the six-nozzle system of CH-47 helicopters. It focuses on the principal valves and fitting assemblies. The CH-47 system varies from the other system (Figure 15-11, page 15-23) in that the hose sections are arranged to provide increased distance. Figure 15-13, page 15-25, shows the main valve and fitting assemblies of all recommended temporary refueling system equipment layouts.

NOTE: All final lengths of discharge hose in temporary systems should be positioned as shown for the hose at the extreme right of each drawing of the system (the other hoses are shown pulled out full length for refueling).
The last 10 feet of dispensing hose should be looped back so that the nozzle can hang on the nozzle hanger that is attached to the ground rod. No hose should be lying forward of the ground rod when an aircraft lands at the nozzle. In a tactical area, the proper layout of the collapsible tanks may have to be modified. The tactical situation, physical limitations of the site, and requirements for protection and camouflage must be weighed against the standards for proper layout. The following concerns must be weighed in specific tactical areas:

- Fuel supplies and tanks may need to be guarded.
- Tanks may need to be shielded from enemy fire.
- Tanks may need to be camouflaged.

- Only limited areas of firm ground to support filled tanks in all types of weather may be available.

Grounding Equipment

In a temporary refueling system, ground the pump, the filter/separator, and each nozzle. For guidance on ground rods and grounding procedures, see Chapter 2.

Positioning Collapsible Tanks

Prepare positions for 3,000-, 10,000-, 20,000-, or 50,000-gallon collapsible tanks. Clear and grade an area for each tank. The grade of the area should not be steep because filled, collapsible tanks tend to creep or roll on a hillside. However, a slight slope toward the manifold end of the tank (not more than 6 inches per 20 feet for rectangular tanks or 3 inches per 20 feet for square tanks) helps drain the tanks when it must be moved. A berm must be built around each tank and an impermeable liner must be added between layers of suitable fill, such that damage to the tank and liner is reduced. The berm must be large enough to hold all the fuel in the tank and one foot of freeboard. Before the walls are built, lay a drainpipe (sections of 4-inch suction hose will do) and close the end of the drainpipe with a valve. Build up the berm over the drainpipe, and then make sure the drainpipe is not blocked or closed. The valve should be kept closed to keep the fuel in the berm in case of a leak or tank rupture, but it may be opened when it is necessary to drain off rainwater. If drainage is a problem in the area, dig out a position for each tank. This will also capture the fuel in case the tank ruptures. The berm dimensions are described below.

- The 3,000-gallon collapsible tank. Build the berm 3 feet high and 18 inches wide at the top. The inside dimensions of the berm should be 15 feet 6 inches by 15 feet 6 inches. Maintain a distance of 3 feet from the edge of the tank to the base of the berm.

- The 10,000-gallon collapsible tank. Build a berm that is 3 feet high and 18 inches wide at the top. Make the inside dimension of the berm 26 feet by 26 feet. Maintain a distance of 3 feet from the edge of the tank to the base of the berm.

- The 20,000-gallon collapsible tank. Build a berm that is 4 feet high and 18 inches wide at the top. The inside dimensions of the firewall should be 35 feet long and 31 feet wide. Maintain a distance of 3 feet from the edge of the tank to the base of the berm.

- The 50,000-gallon collapsible tank. Build a berm that is 4 feet high and 18 inches wide at the top. The inside dimensions of the firewall should be 73 feet long and 33 feet wide. Maintain a distance of 4 feet from the edge of the tank to the base of the berm.

Positioning Fire Extinguishers

Position a fire extinguisher at each refueling nozzle and at the pump assembly. Place the fire extinguishers as shown in Figures 15-6, through 15-8, pages15-17 through 15-20 and 15-10 through 15-12, pages 15-22 through 15-24. Twenty pound carbon dioxide (CO_2) or equivalent capacity dry chemical fire extinguishers are recommended.

PREPARATIONS FOR OPERATIONS

Be sure all safety precautions are taken. Be sure the danger control measures are being used. For example, ensure that no unnecessary vehicles or electrical equipment are within 50 feet of a nozzle. Have landing lights in place, if appropriate. See that members of the ground crew have and are wearing all protective clothing and equipment necessary. Have required warning signs in place. Before daily operations begin, the fuel storage tanks, hoses, nozzles, pumps, filter/separators, bonding and grounding equipment, and fire extinguishers must be checked. These procedures are described in the paragraph Preparation for Operations, on page 15-5.

SEQUENCE OF OPERATIONS

Following the sequence of actions in refueling is vital to the safety of operations. This sequence is described in the paragraph Sequence of Operations, page 15-6.

EMERGENCY FIRE AND RESCUE PROCEDURES

The best preparation for coping with an emergency is the fire-fighting and rescue training that all refueling personnel should receive. The procedures and guidelines of what personnel should do in a fire or crash emergency are found in Chapter 19.

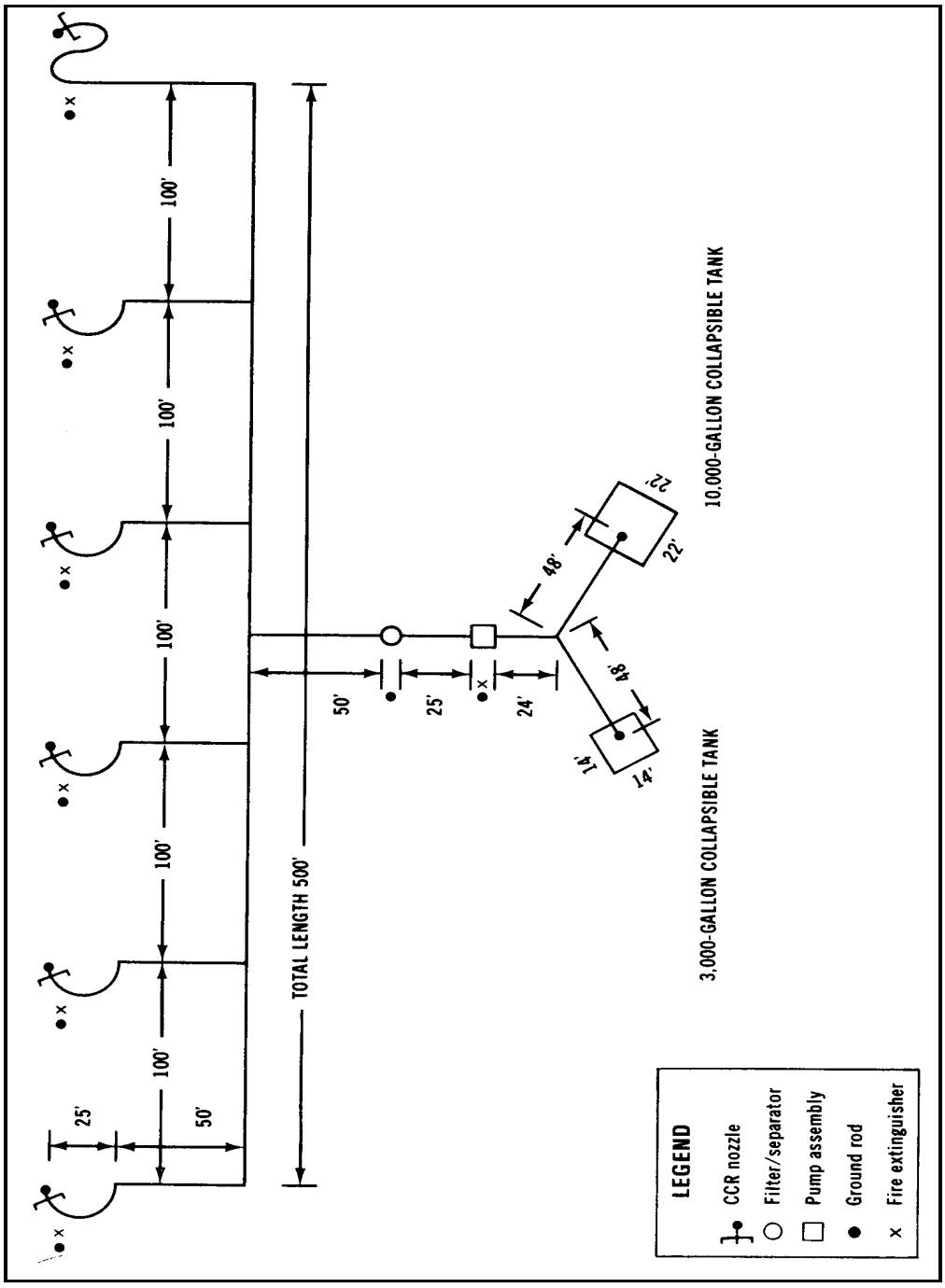


Figure 15-6. Layout of six-nozzle temporary refueling system for OH-6, OH-58, AH-1, and UH-1 helicopters

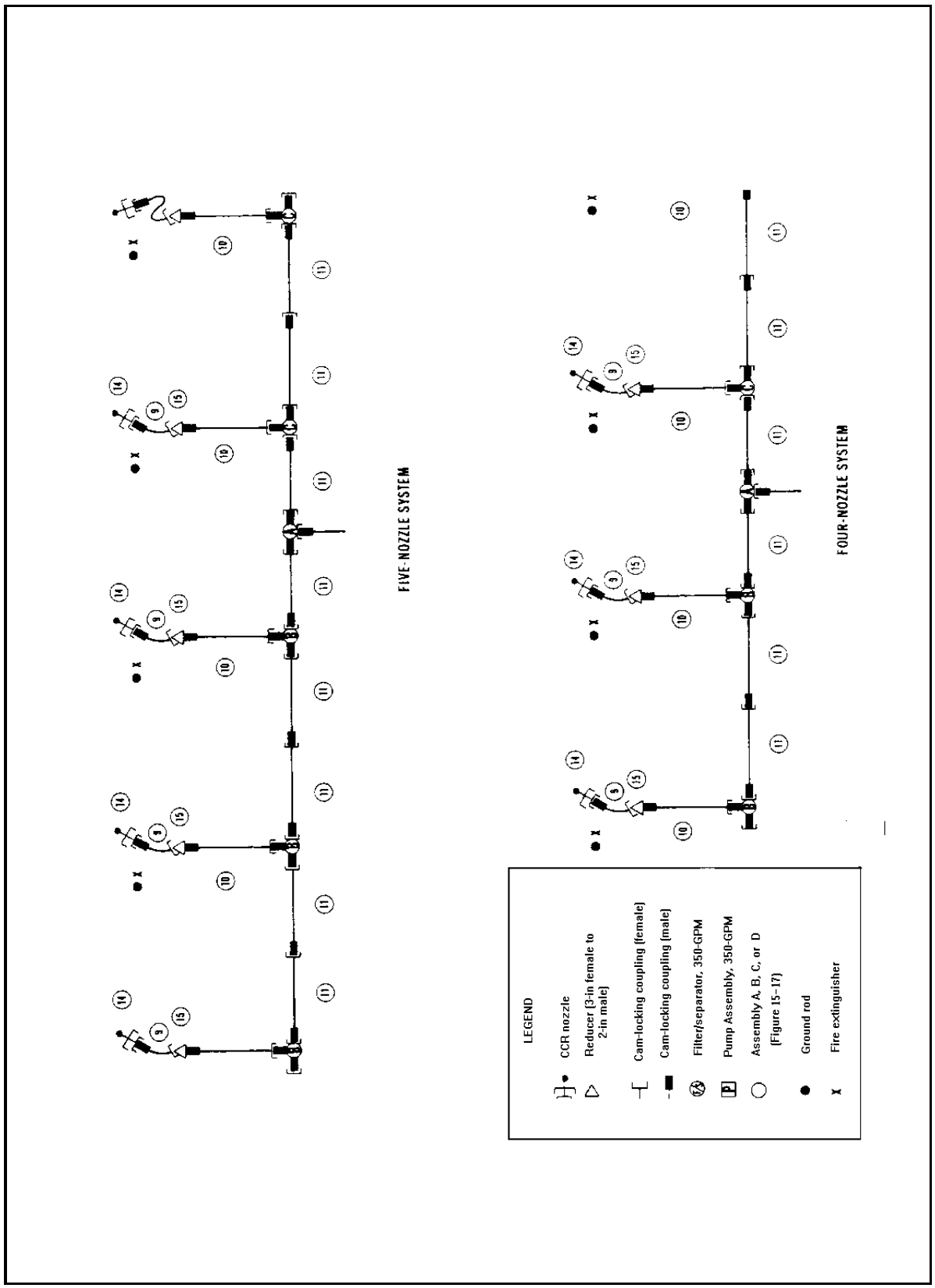


Figure 15-7. Layout of five-, four-, three-,and two-nozzle refueling system for OH-6, OH-58, AH-1, and UH-1 helicopters

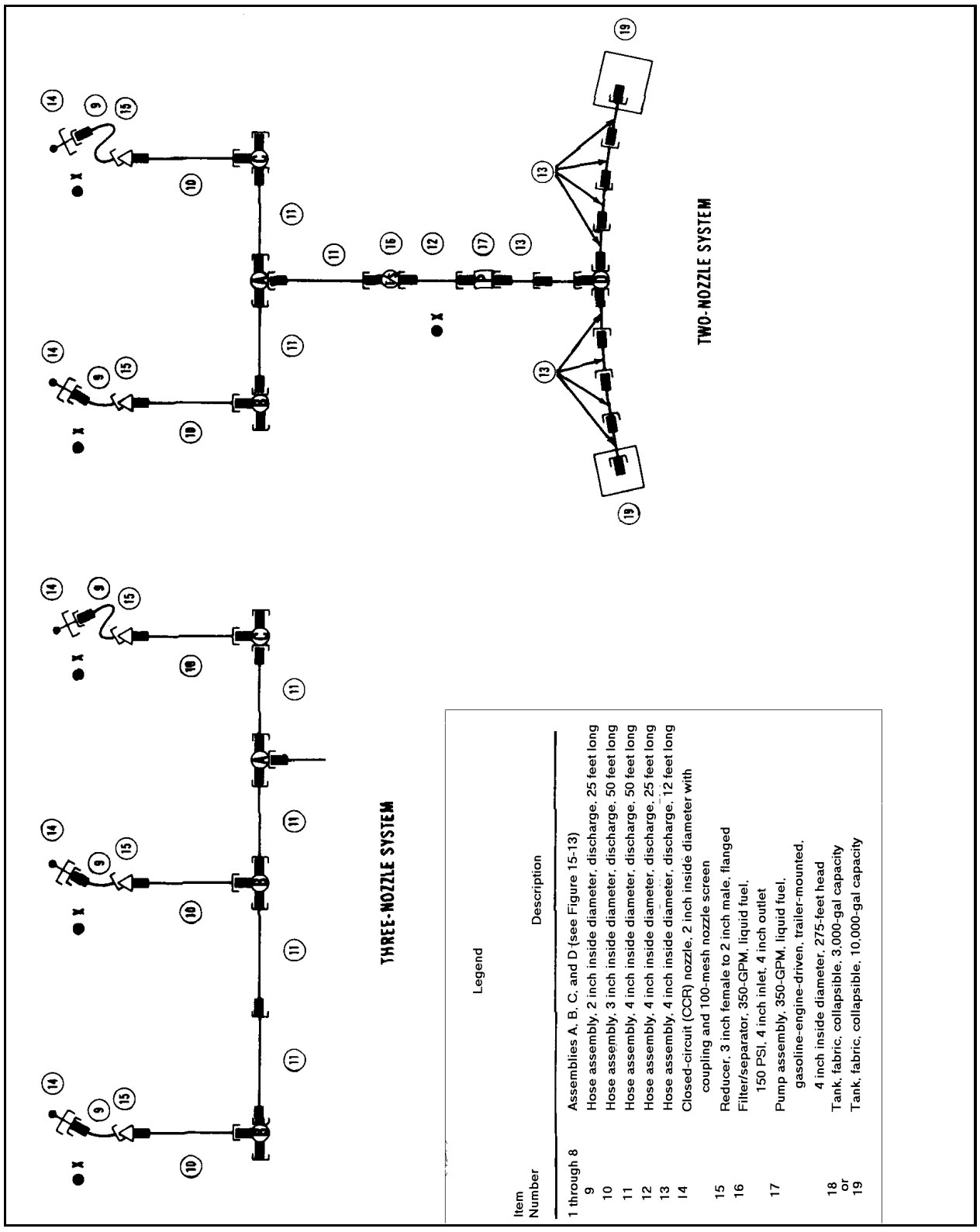


Figure 15-7. Layout of five-,four-,three-, and two-nozzle refueling system for OH-6, OH-58, AH-1, and UH-1 helicopters (continued)

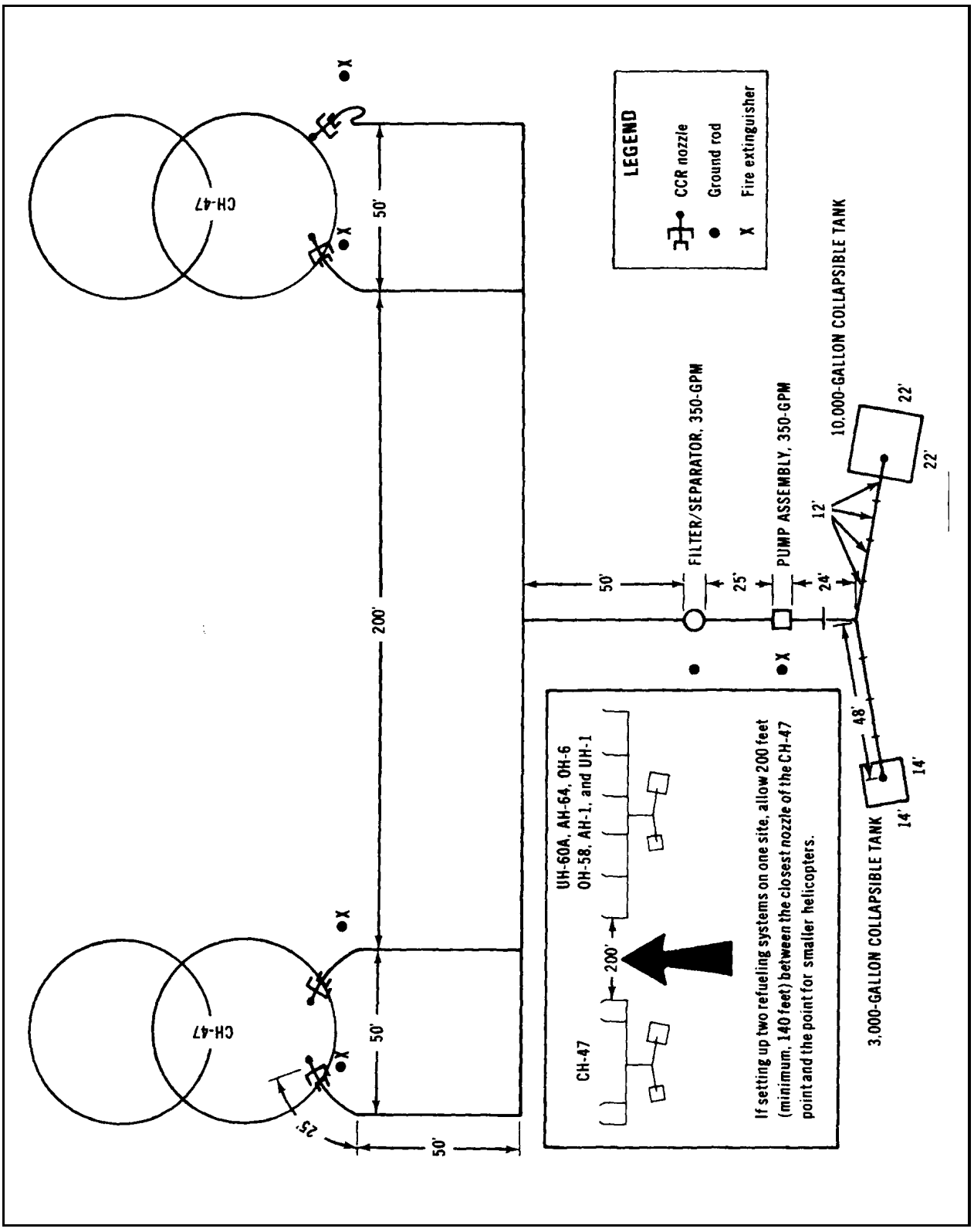


Figure 15-8. Layout of temporary refueling system for CH-47 helicopters

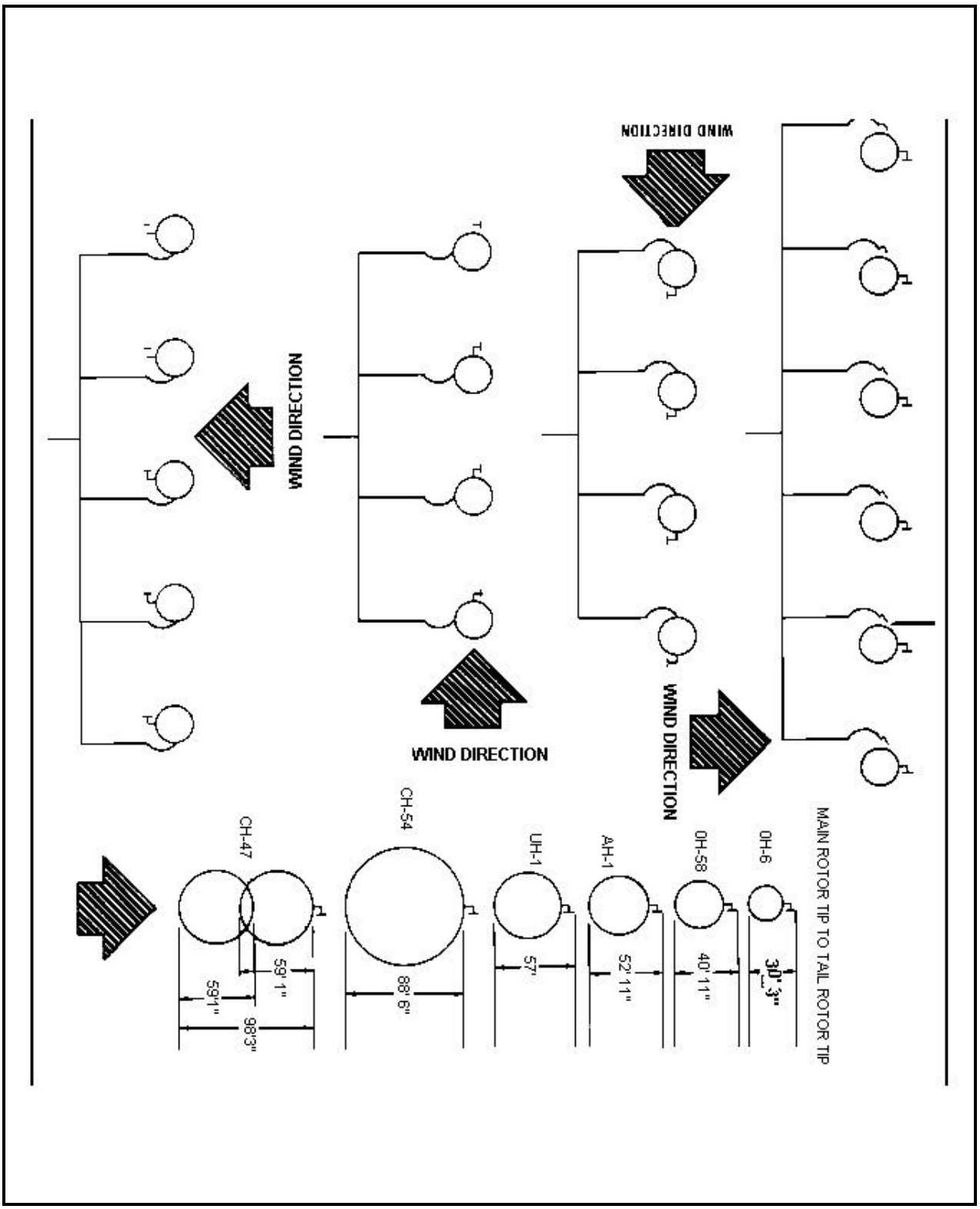


Figure 15-9. Temporary refueling systems under various wind conditions

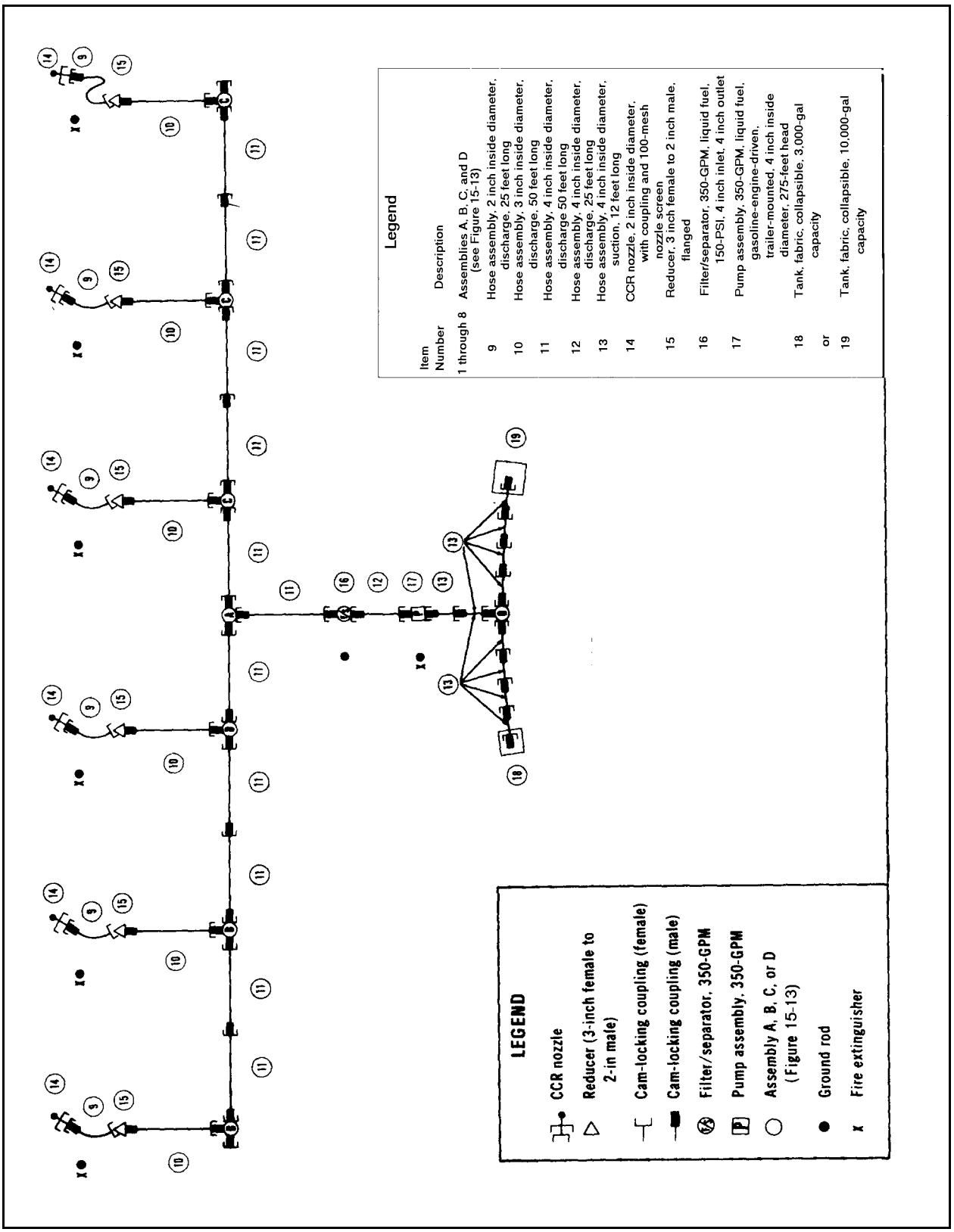


Figure 15-10. Suggested layout for six-nozzle refueling system for OH-6, OH-58, AH-1, UH-60,AH-64, and UH-1

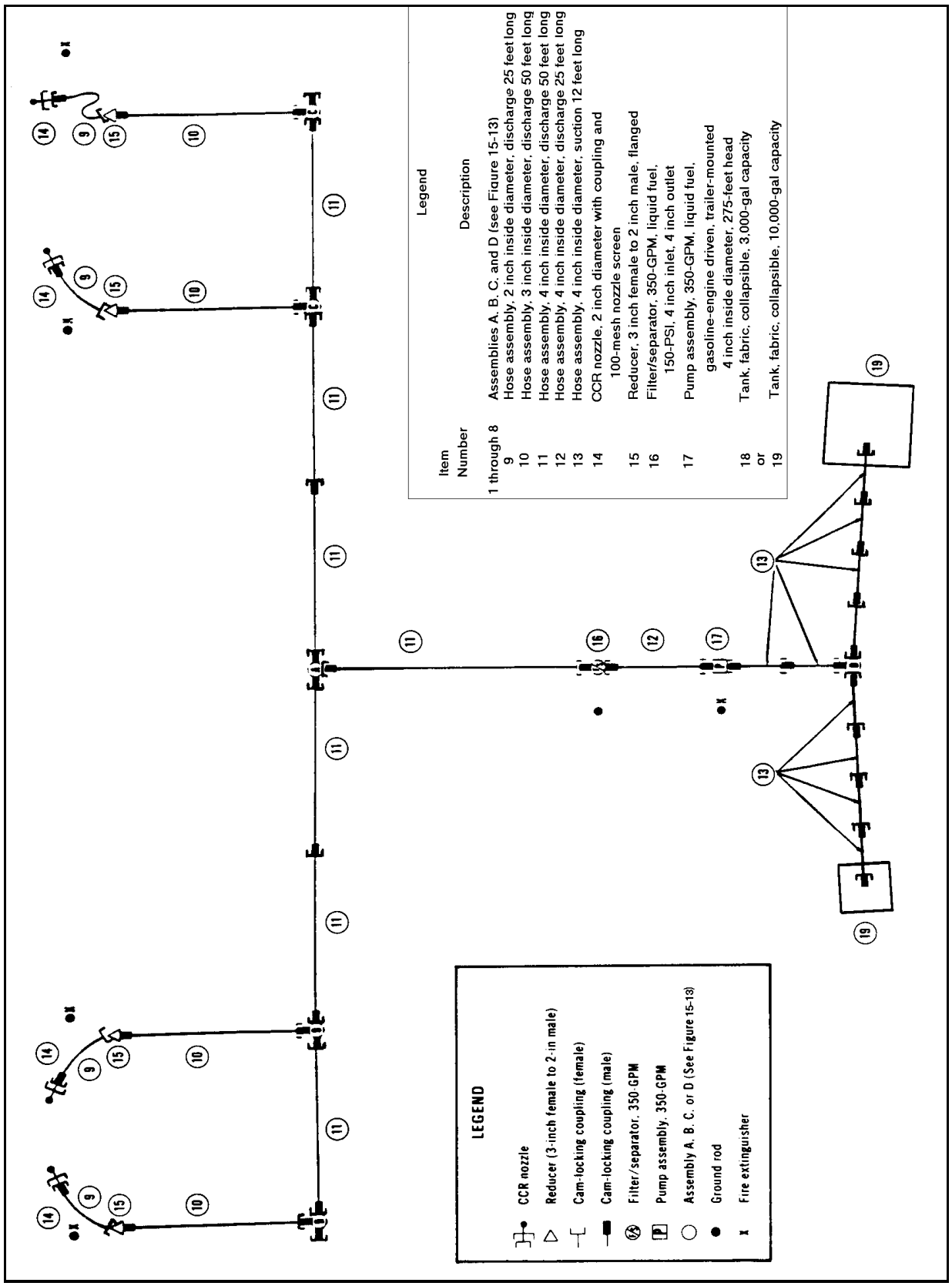


Figure 15-11. Suggested layout of refueling system for CH-47 helicopters

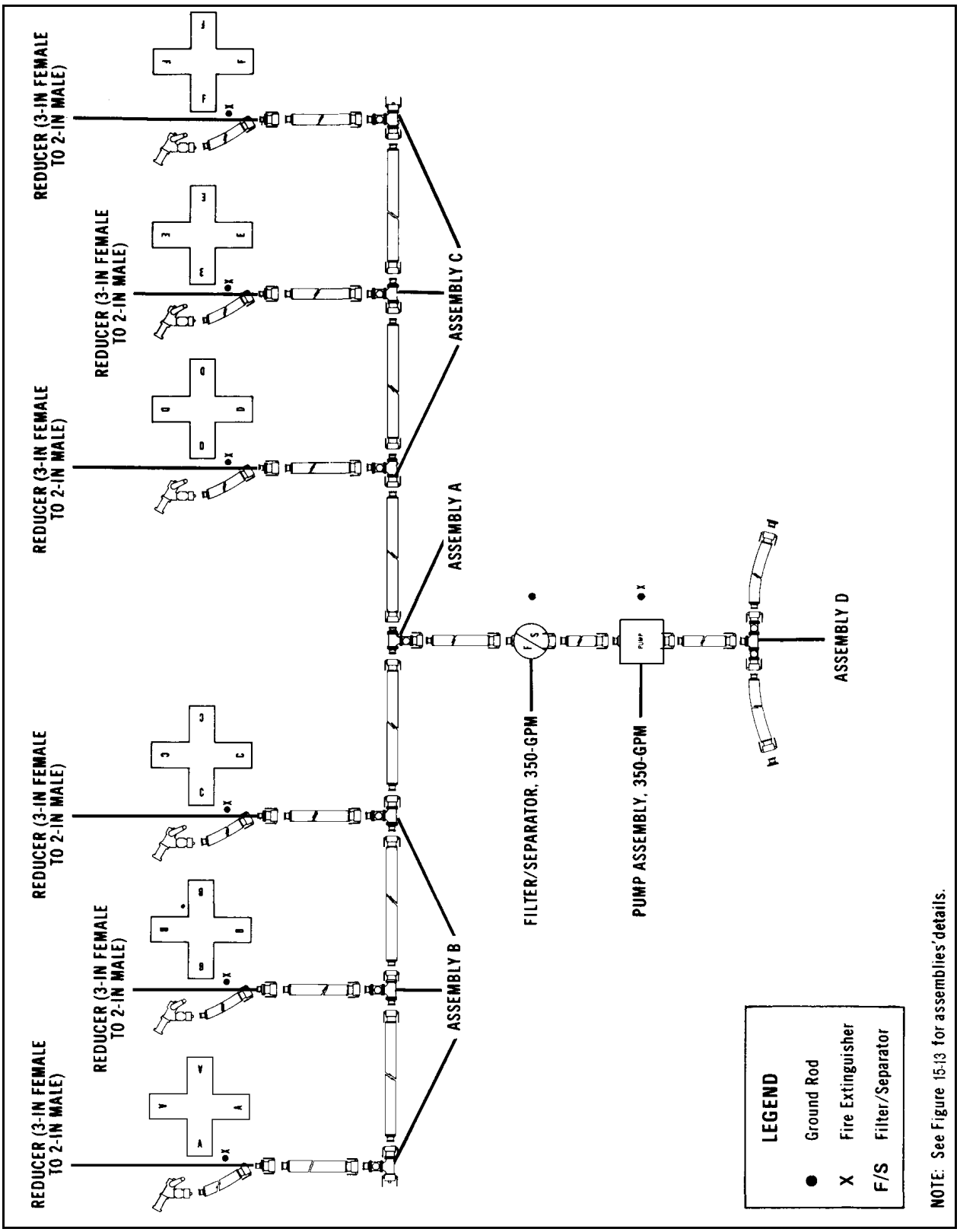
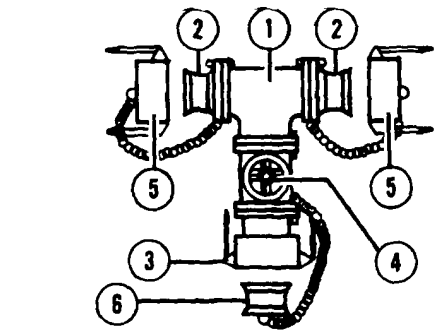
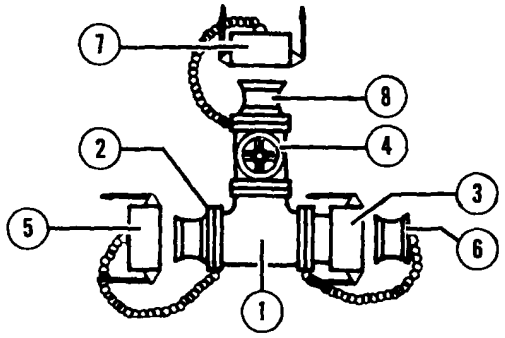


Figure 15-12. Six nozzle refueling system for CH-47 helicopters showing principal valves and fitting assemblies



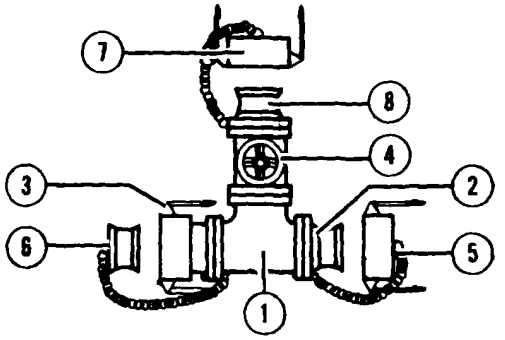
ASSEMBLY A

Item	Description	Quantity	NSN
1	Tee, 4" X 4" X 4"	1	4730-00-840-5346
2	Coupling, male, 4", flanged	2	4730-00-840-5347
3	Coupling, female, 4", flanged	1	4730-00-840-5348
4	Valve, gate, 4", flanged	1	4820-00-986-7760
5	Cap, dust, 4"	2	4730-00-640-6156
6	Plug, dust, 4"	2	4730-00-640-6188



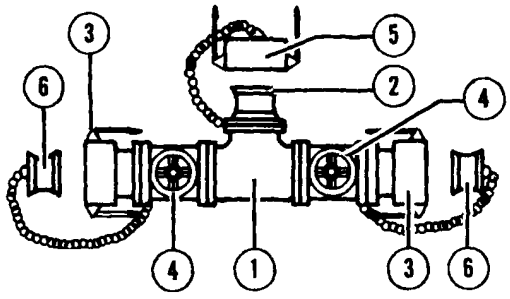
ASSEMBLY B

Item	Description	Quantity	NSN
1	Tee, 4" X 4" X 4"	1	4730-00-840-5346
2	Coupling, male, 4", flanged	1	4730-00-840-5347
3	Coupling, female, 4", flanged	1	4730-00-840-5348
4	Valve, gate, 4", flanged	1	4820-00-986-7760
5	Cap, dust, 4"	1	4730-00-640-6156
6	Plug, dust, 4"	1	4730-00-640-6188
7	Cap, dust, 3"	1	4730-00-649-9097
8	Reducer, flanged, 4", female to 3" male	1	4730-00-075-2423



ASSEMBLY C

Item	Description	Quantity	NSN
1	Tee, 4" X 4" X 4"	1	4730-00-840-5346
2	Coupling, male, 4", flanged	1	4730-00-840-5347
3	Coupling, female, 4", flanged	1	4730-00-840-5348
4	Valve, gate, 4", flanged	1	4820-00-986-7760
5	Cap, dust, 4"	1	4730-00-640-6156
6	Plug, dust, 4"	1	4730-00-640-6188
7	Cap, dust, 3"	1	4730-00-649-9097
8	Reducer, flanged, 4", female to 3" male	1	4730-00-075-2423



ASSEMBLY D

Item	Description	Quantity	NSN
1	Tee, 4" X 4" X 4"	1	4730-00-840-5346
2	Coupling, male, 4", flanged	1	4730-00-840-5347
3	Coupling, female, 4", flanged	2	4730-00-840-5348
4	Valve, gate, 4", flanged	2	4820-00-986-7760
5	Cap, dust, 4"	1	4730-00-640-6156
6	Plug, dust, 4"	2	4730-00-640-6188

Figure 15-13. Principal valves and fitting assemblies of temporary refueling systems

Section III. HEMTT Tanker Aviation Refueling System

CHARACTERISTICS

The HTARS is a kit that consists of enough hoses, fittings, and nozzles to expand the HEMTT tankers capability to hot refuel up to four helicopters simultaneously using the on-board fuel-servicing pump. The equipment is lightweight, has manually operated controls, and is equipped with valved and swivel adapters that allow connections between camlock and unisex type fittings. See Figure 15-14, for unisex connections. This equipment can be used in forward areas. It can be transported in the storage box of the HEMTT tanker.

Figure 15-14. Unisex connections

EQUIPMENT

The HTARS (NSN 4930-01-269-2273) consists of discharge hoses, valves and fittings, nozzles, and overpack spares. The components of the system are shown in Figure 15-15, page 15-27.

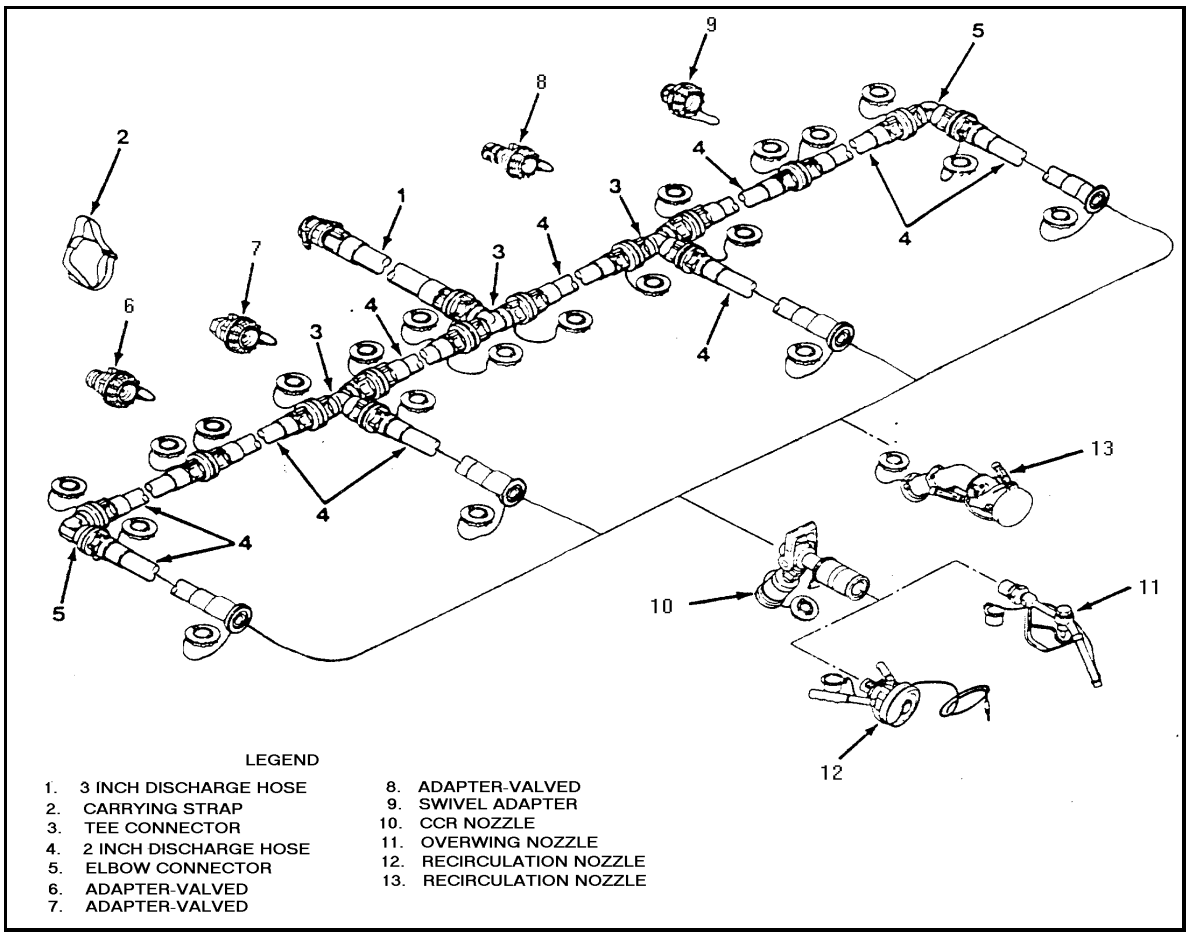


Figure 15-15. HTARS components and layout

Discharge Hoses

The system consists of both 2- and 3-inch discharge hoses. One 3-inch by 50-foot hose is used to connect the HTARS to the HEMTT tanker. Ten 2-inch by 50-foot discharge hoses transfer the fuel from the HEMTT tanker to the aircraft. Six hoses are used in the manifold and one in each of the four issue lines. There are 11 carrying straps for easy handling of rolled hoses.

Valves and Fittings

The following valves and fittings are components of the HTARS:

- Three T-connectors with a flow control handle to open and close the valve. The T-connector splits the flow of fuel.
- Two elbow connectors to direct the flow of fuel.
- Three valved adapters to connect threaded and unisex parts as well as camlock and unisex parts.
- One swivel adapter to connect camlock and unisex parts.

Nozzles

The HTARS is equipped with four types of nozzles. There are four CCR nozzles with unisex adapters as shown in Figure 15-16, page 15-31. Four overwing nozzles can be mated to the CCR nozzles to perform open-port refueling. The system has one recirculation nozzle (Figure 15-17, page 15-31) that can be connected to the

HEMTT tanker to recirculate fuel in the system.. It is equipped with a fuel sample port to obtain a sample of fuel. The recirculation nozzle mates to the CCR nozzle. There are four D-1 nozzles to equip the system for center-point refueling (Figure 15-18, page 15-31).

Overpack Spares

Each system has one overpack spare with additional parts and accessories. The following parts are in the overpack spares: one T-connector, one 2-inch by 50-foot discharge hose, one carrying strap for easier handling of the rolled hoses, 10 dust seals, two dust caps, and four grounding rods.

Other Required Items

Other items of equipment are required to conduct aircraft refueling operations with the HTARS. A minimum of five fire extinguishers are required--one to be within reach of the on-board pump and one at each refueling point. The signs described in Chapter 2 will need to be posted at the refueling site. Also, water cans and spill containers will need to be available.

SITE LAYOUT

When planning the site layout for HTARS, you must consider the five factors in addition to METT-T. The factors to be considered are spacing between aircraft, wind direction, vapor collection, drainage, and camouflage. These factors are described in Section I, page 15-2 and 15-3.

SITE PREPARATION

The immediate refueling area, paths of approach, and hover lanes should be cleared before operations. All sticks, stones, and debris should be cleared to prevent them from being sucked up or transformed into dangerous projectiles by the rotor wash.

EQUIPMENT LAYOUT

Lay out the HTARS in a manner most practical for the situation. Avoid obstacles and take advantage of terrain features. When laying out the equipment, never remove a dust cap until ready to make a connection. This will prevent dust or particulate matter from entering the system and causing fuel contamination. Likewise, when disassembling, cap equipment immediately after uncoupling. When laying out the HTARS, follow the procedures below.

Position Vehicle

Select the most level ground available to position the M978 HEMTT tanker. Avoid areas near bodies of water to avoid contamination and use the highest ground available to prevent vapor accumulation. When positioning the vehicle, remember the system should be laid out so that helicopters can land and refuel into a headwind or cross-wind. Make the most use of natural concealment. Position the vehicle to allow easy exit without blocking exits. After positioning vehicle, drive a ground rod at least 3 feet into the ground (specific depths for soil types are described in Chapter 2), attach the vehicle ground cable to the ground rod, position fire extinguishers within easy reach, and post NO SMOKING signs.

Connect System Components

Connect the 3-inch by 50-foot discharge hose to the suction hose on the HEMTT tanker (the tanker suction hose is connected to the bulk receptacle filtered on the HEMTT tanker). Connect the T-to the 3-inch discharge hose. Roll a 2-inch by 50-foot discharge hose from both sides of the T-and connect both discharge hoses to the to the T. Connect another T to the end of each 2-inch discharge hose. Roll out and connect two 2-inch by 50-foot discharge hoses to each outer tee. At the end of both outer 2-inch discharge hoses, connect an elbow fitting. Unroll and connect a 2-inch by 50-foot discharge hose to each of the two Ts and elbow fittings.. Put FLOW handles in flow position after connections are made as shown in Figure 15-19, page 15-32.

NOTE: The unisex fittings will not connect if the FLOW handles are in the flow position.

Connect Nozzles

Connect the type of nozzle to be used for the operation to the 2-inch discharge hose at each point. The CCR and D-1 nozzle connect to the 2-inch discharge hose. The overwing (open-port) and recirculation nozzle mate to the outlet of the CCR nozzle. These nozzles are described in Chapter 14. Also, refer to TM 5-4930-235-13&P for information on nozzles.

Ground Equipment

Drive a grounding rod into the ground 10 feet back from the end of each dispensing hose (ground rod requirements are described in Chapter 2). Loop the dispensing hose at each point back to the ground rod and hang the nozzle on the ground rod hanger. Connect the clip of the nozzle grounding wire to the ground rod at each point. At each point, place a CO_2 or dry chemical fire extinguisher. Also, place a spill container and a filled 5-gallon water can at each point.

Camouflage Equipment

Camouflage the truck and system to the extent required by the tactical situation. Natural concealment such as woodlines, hedgerows, vegetation, and natural terrain contours should be used when possible. Straight lines of the hoseline can be broken up by breaking branches and placing them under the hoseline to hold them in place. Camouflage netting may be used for the vehicle and parts of the system that are not near the refuel points. Camouflage must be staked down securely to keep it from being torn loose by rotor wash.

PREPARATION FOR OPERATION

Ensure all safety precautions have been taken. Verify that all safety and fire-fighting equipment is in place and serviceable. Check landing lights if they are required. Perform daily and before operations checks on the HEMTT tanker IAW TM 9-2320-279-10-1 and on the HTARS IAW TM 5-4930-237-10. Inspect the discharge hoses, valves and fittings, nozzles, and grounding systems. Ensure that all refueling personnel have and are wearing the proper protective clothing (Chapter 2). As soon as the system is full of fuel and ready to operate each day, draw a sample from each nozzle. If the fuel does not pass tests and inspections, do not use it. Isolate it, resample it, send the sample to the supporting laboratory, and await the laboratory's instructions on disposition.

SEQUENCE OF OPERATIONS

The HTARS has two primary modes of operation, refuel and recirculation. In the refueling mode, fuel is pumped from the HEMTT tanker through the system hoses to the refueling points (nozzles). In the recirculation mode, the refueling nozzle (CCR or D-1) is disconnected from the refueling point and the recirculation nozzle is connected. The recirculation nozzle is connected to the HEMTT tanker and fuel circulates through the system hoses and back to the tanker. The HTARS can operate in both modes at the same time.

Refueling Mode

To operate the HTARS in the refueling mode, follow these procedures:

- Start and operate the HEMTT tanker IAW TM 9-2320-279-10-1.
- Ensure the soldier manning the nozzle guides the aircraft into position using the signals described in Chapter 2 Check with the pilot to be sure that all armaments are on SAFE.
- Deplane the crew and passengers. Passengers must go to the designated passenger marshaling area. Members of the crew, except the pilot or copilot who may remain at the controls if necessary, should deplane and assist with the refueling, or man fire extinguishers.
- Position a fire extinguisher at the HEMTT tanker and at each nozzle point. Carry the nozzle fire extinguisher out to the aircraft, and place it within reach of the aircraft fill port.
- Ensure the pilot notifies his commander that he will be off the air during refueling. He may monitor his radios during refueling, but he should never transmit. The crew chief and pilot may talk by intercom during refueling.

NOTE: Ground the aircraft. Grounding of aircraft during refueling is no longer required by NFPA standards 77 and 407. Grounding will not prevent sparking at the fuel surface. (See Chapter 2, Section III for more information).

- Bond the nozzle to the aircraft in one of two ways. Either by inserting the bonding plug into the plug receiver or attaching the clip of the nozzle bonding cable to a bare metal part of the aircraft other than the antenna.
- After the nozzle is bonded to the aircraft, remove the dust cap from the nozzle and open the aircraft's fill port.
- Verify that all valves between the HEMTT tanker and the fuel nozzle are open.
- Do not leave the nozzle at any time during refueling. Stop the flow of fuel if there is any emergency at the refueling point. Three types of nozzles can be used for aircraft refueling. Use of the center point (D-1), CCR, and overwing (open-port) nozzle are described below.
  - Center point refueling nozzle operation. Remove the dust cover from the end of the nozzle body. Grasp the handles and hold the nozzle in alignment with the aircraft refueling adapter. Press the nozzle body against the adapter and turn handles to the right until the end of the nozzle mates and locks to the aircraft refueling adapter. Rotate the control handle to the full OPEN position. The pilot will signal when the tank is full. To disconnect, rotate the control lever to the full CLOSED position. Grasp the handles and rotate the nozzle body to the left until it disconnects from the aircraft adapter.
  - CCR nozzle. Mate the CCR nozzle to the fill port. Pull back on the control handle latch, and then push the flow control handle up toward the aircraft into the FLOW position. If the aircraft is to be filled completely, watch the back of the nozzle. A red indicator will pop out of the back of the nozzle when the aircraft tank is full. Pull back on the flow control handle to move it into the NO FLOW position. Unlatch the nozzle.
  - Overwing (open-port) nozzle. Rapid refueling (hot) using the open-port nozzle is restricted to combat or vital training (Chapter 14). The decision to use the open-port nozzle must be made by the commander. The open-port nozzle is mated to the CCR nozzle. The end of the nozzle is placed in the aircraft fuel tank adapter. Set the CCR nozzle to FLOW. Squeeze the control handle to dispense fuel. Watch the fill port when filling the tank. As the tank nears full, ease up on the trigger and finish filling more slowly. When the tank is full, release the trigger. Move the flow control handle on the CCR nozzle to the NO FLOW position. Be sure that flow has stopped completely before removing the nozzle from the fill port.
- Replace the cover of the aircraft fill port and put the dust cap back on the nozzle.
- Unplug the nozzle bonding plug or release the bonding clip. Carry the nozzle back to the hanger. Do not lay it or drag it across the ground.
- Release the grounding cable clip from the aircraft.
- Take the fire extinguisher back to a position near the nozzle hanger.
- Have the aircrew and passengers reboard the aircraft.
- Turn off the pump on the HEMTT tanker if no other aircraft is being refueled.
- After receiving clearance, the aircraft lifts off.

Recirculation Mode

One recirculation nozzle is supplied with the HTARS. To recirculate the entire system, the recirculation procedure must be performed for each refueling point. To perform recirculation, follow the procedures listed below.

- Connect the recirculation nozzle to the refueling point (CCR nozzle).
- Reposition hoses as required to reach the HEMTT tanker.
- Connect the recirculation nozzle to the HEMTT tanker bottom loading receptacle A. Press the nozzle body against the A receptacle and turn the handles to the right until the nozzle body locks firmly to the receptacle.
- Start and operate the HEMTT tanker IAW TM 9-2320-279-10.
- Set the CCR nozzle to OPEN. Rotate the recirculation nozzle control lever to the full OPEN position.

• If needed, fuel samples may be taken during the recirculation mode. The recirculation nozzle is equipped with a hand-operated ball valve to allow sampling of the fuel entering the tanker. To take the fuel sample, place the end of the tube in the sample container. Slowly move the control handle on the ball valve to the open position. When sampling is complete, set the control handle on the ball valve to the closed position.

• When recirculation is complete, set the recirculation nozzle control handle to the closed position. Set the CCR nozzle to the NO FLOW position.

• Shut down the HEMTT tanker IAW TM 9-2320-279-10-1.

• Disconnect the recirculation nozzle from the HEMTT tanker.

EMERGENCY FIRE AND RESCUE PROCEDURES

The best preparation for coping with an emergency is the fire-fighting and rescue training that all refueling personnel should receive. The procedures and guidelines of what personnel should do in a fire or crash emergency are found in Chapter 19.

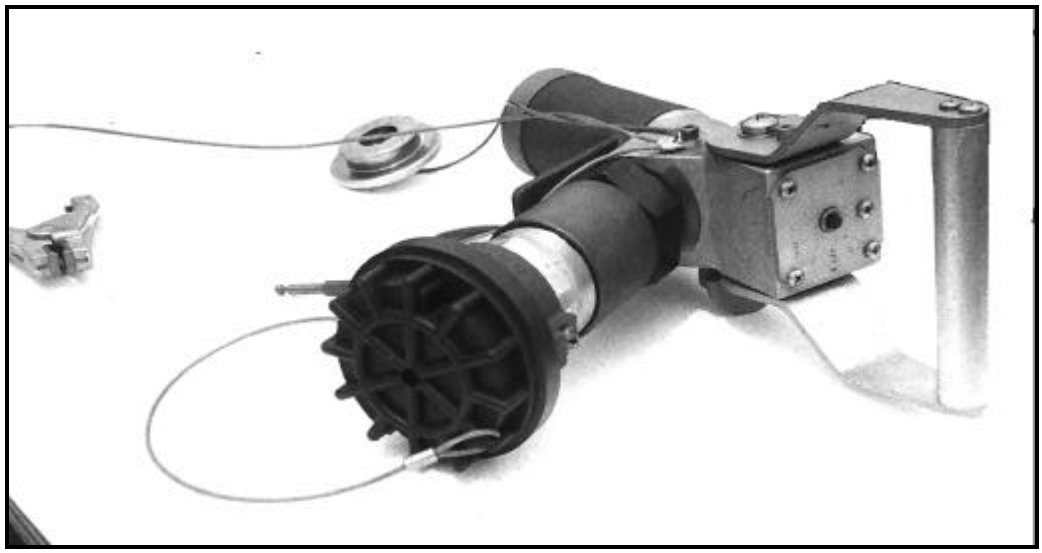


Figure 15-16. Model 125-1000 CCR nozzle

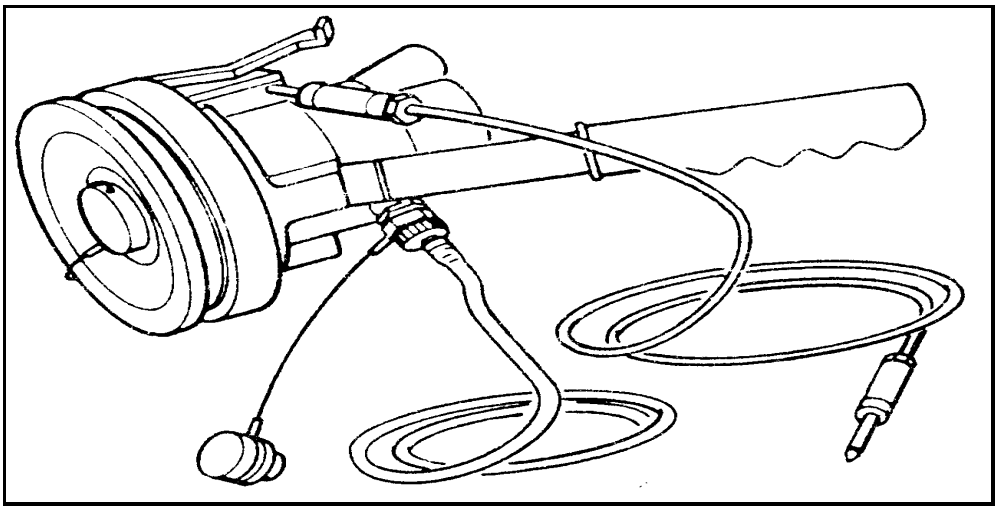


Figure 15-17. Recirculation nozzle

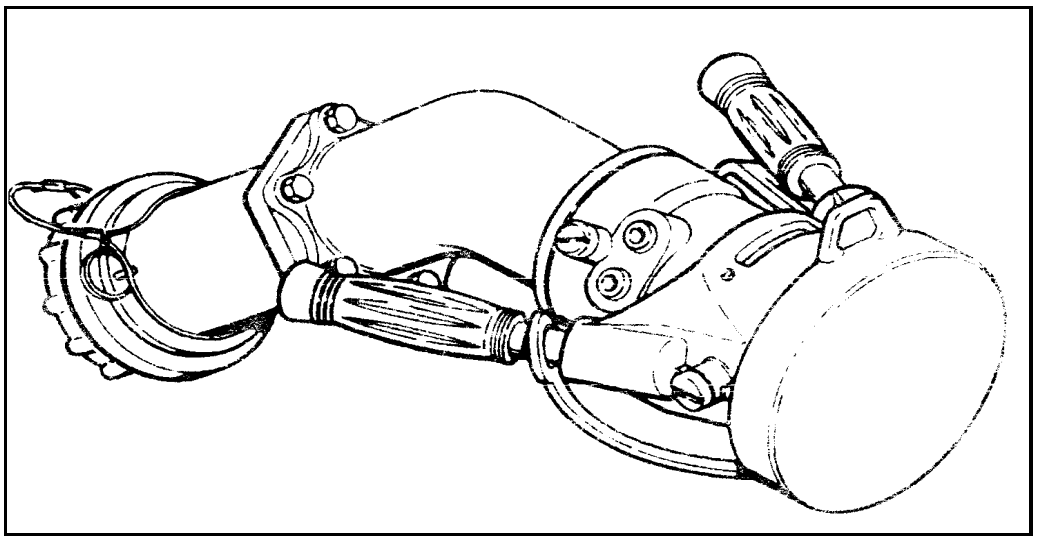
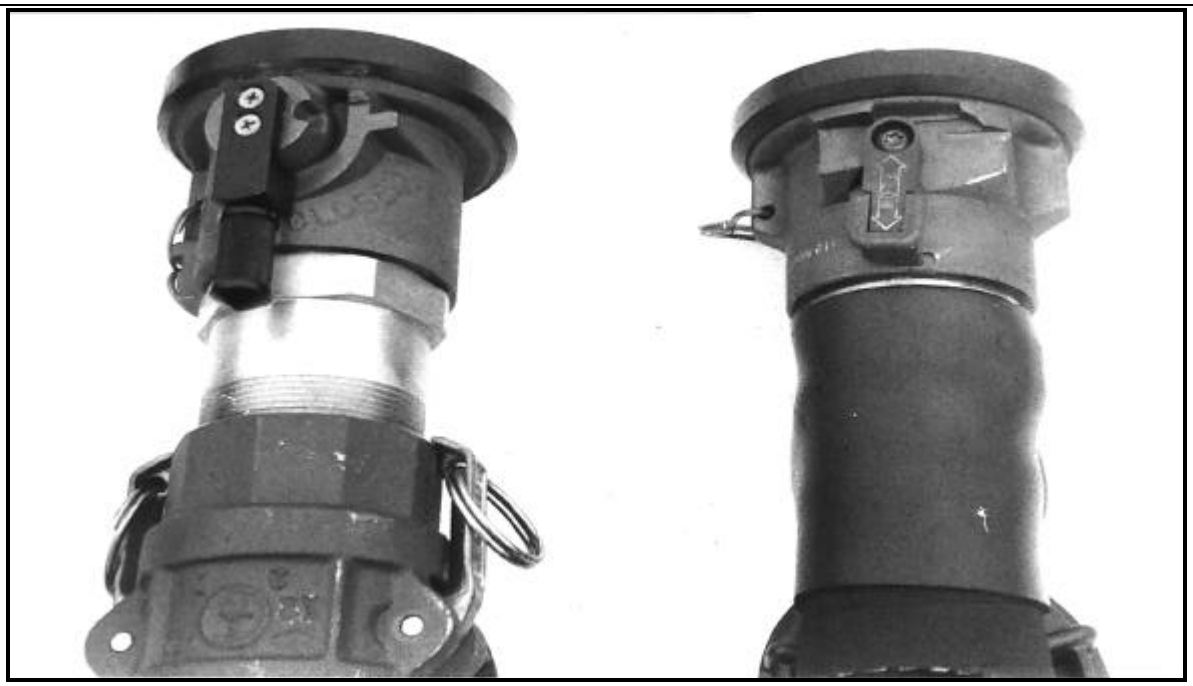
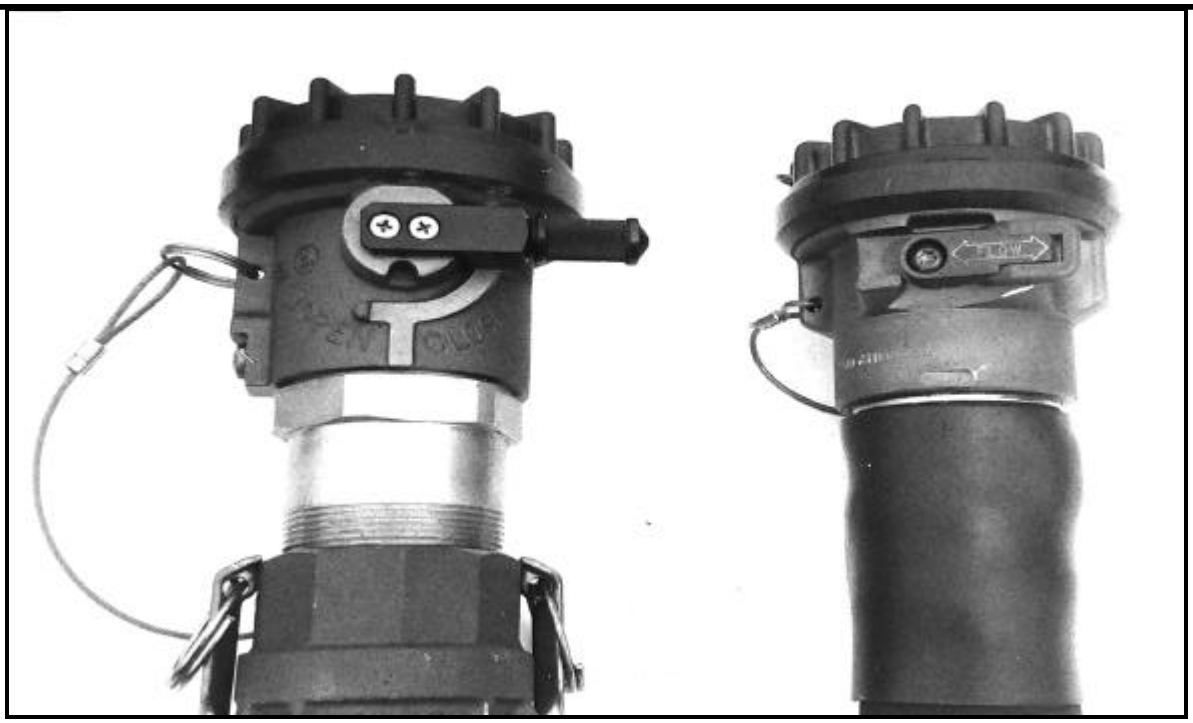


Figure 15-18. D-1 center-point refueling nozzle



FLOW



NO FLOW

Figure 15-19. Discharge hose FLOW handles

Section IV. Fat Cow (CH-47) FARE

PURPOSE

To provide a continuous presence of aviation assets on the modern battlefield requires greater FARP mobility. Logistical requirements may require a more rapid and mobile response for aviation fuels than can be met by tank vehicles or the sling loading of collapsible drums into an area of operation. Aircraft-to-aircraft refueling offers a reduction in turnaround time at unit trains through rapid insertion, refueling of aircraft, and extraction of Class III assets. This refueling technique also reduces the time that supporting as well as supported aircraft are on the ground and most vulnerable. Since it is possible to perform this operation closer to the FLOT, there is a reduction in the loss of lethal aviation assets due to refueling/rearming thus increasing force projection. Aircraft-to-aircraft refueling systems and procedures for the Fat Cow are given below.

Fat Cow

The CH-47 has capability to pump a maximum of 2320 gallons of fuel to other aircraft. Fuel is contained in standard noncrashworthy 600-gallon ERFS tanks (crashworthy tanks are preferred) located in the cargo compartment of the tanker aircraft. One to four tanks may be installed with enough refuel equipment to set up either two refuel points per aircraft. In any configuration, the FARP can easily be set up and operational within 10 minutes of landing. Also, the on board fuel can also be used to extend the range of the tanker aircraft.

Equipment

Equipment used in Fat Cow refueling operations consists of ERFS tanks, electric pump, filter/separator, hoses, nozzles, grounding equipment and valves and fittings. There is currently no unique system for aircraft-to-aircraft refueling. The system in use combines components of the ERFS, FARE, and HTARS. Major components are discussed below.

- Tanks. The Fat Cow uses up to four ERFS tanks. They are metal, noncrashworthy, 600-gallon capacity tanks. Crashworthy tanks are preferred. The tanks can be filled to 580 gallons providing up to 2320 gallons for refueling other aircraft. The tanks are secured to the aircraft using 5,000-and 10,000-pound cargo strap assemblies. Although noncrashworthy tanks are currently in use, they should be replaced with crashworthy tanks when available.

- Pumping assembly. Electrically driven, explosion-proof, pumps are located aft of the rearmost tank, secured to the floor, and connected to the manifold. The pump receives AC and DC power from the aircraft's electrical system and is connected to the utility receptacles in the cabin.

- Filter/separator. A 100-GPM filter/separator is secured to the aircraft floor. This is the same filter/separator used with the FARE system. It contains five elements, each in a canister, that remove free water and particulate contaminants. It has an air vent valve, a pressure differential indicator, a water sight glass, and a water drain valve that is hand operated. For more information on the 100-GPM filter/separator, see Chapter 21.

- Hoses. The hoses used for the Fat Cow should be 2-inch in diameter. Use suction hoses on the suction side of the pump and collapsible discharge hose on the dispensing side of the system. Use enough length of hose to maintain required spacing between refueling points and between tanker aircraft and refueling points. The standard camlocking hoses in the FARE system can be used. However, the unisex, dry-break couplings as used in the HTARS are recommended because of environmental considerations.

- Fittings, valves, and nozzles. Fittings, valves, and nozzles used for the Fat Cow are the same as those used for the FARE and HTARS described in Sections I and III. A Y-fitting is used between the discharge hose following the filter/separator and the discharge hose to the refueling points. Butterfly valves may be inserted for quick, positive shutoff within the system when camlocking hoses are used. HTARS hoses have FLOW-NO-FLOW valves at the dry break connections. The nozzles used are the same as those used on the FARE: CCR and D-1 nozzles. See Chapter 14 and the previous sections of this chapter for more information.

Site Selection

Follow the general guidelines for site selection covered in the previous sections. The landing zone should be large enough to accommodate the tanker aircraft with minimum spacing between refueling points (see Table 15-1). For multitanker aircraft operations maintain a minimum of 300 feet separation between tanker aircraft. Ensure the ground can support the aircraft and operation. Avoid wet, snow-covered or muddy ground and thick brush.

ADVANTAGES/DISADVANTAGES OF DEPLOYMENT

Advantages

The advantages of the Fat Cow (CH-47) FARE are given below.

- The CH-47 is an instant FARP. Once the CH-47 is on the ground, the system can be ready for refueling within 10 minutes.
- The system can be displaced quickly. When refueling operations are completed, the FARP is packed up, the CH-47 takes off, and the site is cleared within minutes.
- The Fat Cow is useful for special operations.

Disadvantages

The disadvantages of the Fat Cow are given below.

- The ERFS tanks are airworthy when installed, operated, and maintained as described in TM 55-1560-307-13&P. With this configuration, however, fuel can leak into the cabin and a catastrophic incident can occur in the event of a hard landing or an accident. When the noncrashworthy ERFS tanks are installed, the potential for fires during a crash increases.
- The armanents of the CH-47 provide limited protection. Therefore, advance planning is required when reconnaissance and/or attack elements are used to escort the CH-47 with Fat Cow installed.
- The aircraft should be shut down and blades secured to prevent safety hazards. The rotor wash from the CH-47 presents a safety hazard to smaller aircraft.
- The CH-47 burns a tremendous amount of fuel; this must be planned for logistically.
- The signature of the CH-47 makes it vulnerable to detection and attack.
- Use of the Fat Cow diverts valuable aviation assets from other missions. It may be more advantageous to perform the refuel mission with other refueling systems.

Section V. C-17 FARP USING THE HTARS

PURPOSE

Another option for greater FARP mobility is the C-17 FARP using the HTARS, 100-GPM pump, and 100-GPM filter/separator (for fuel post operations evacuation from system). The C-17 aircraft is able to deploy to forward areas where only short runways and limited ramp spaces are available. The C-17 aircraft will land in a forward area to act as a ground tanker to provide fuel to receivers on the ground. The receivers can be aircraft, trucks, bladders, or other equipment. The C-17 can deliver fuel through either one or both of its single point receptacles. The C-17 booster pumps are used to defuel the aircraft using the HTARS and additional Army components. Defueling can be done up to a rate of 520-GPM, depending on the number of booster pumps used.

Site Considerations

The site selected for C-17 FARP operations must be consistent with C-17 capabilities. The C-17 is can operate from small airfields with limited supporting infrastructure. The airfield runway must be 3,000 to 5,000 feet long and 90 feet wide. A paved runway is not required; it may be merely graded and compacted gravel or clay. A 500- by 200-foot area is required for the FARP site.

Equipment

Required equipment includes: HTARS (see Section III for description), two 100-GPM filter/separators (see Chapter 21), five fire extinguishers, four water cans, and four spill containers. A 100-GPM pump (see Chapter 20) is required for post operations fuel evacuation of the system.

Layout

Configure the HTARS and additional components as shown in Figure 15-20, page 15-37. Required minimum distance between aircraft must be achieved. Lay out the system in the most practical manner taking advantage of any terrain features. When laying out the equipment, never remove a dust cap until ready to make a connection. This will reduce the chance of dust or particulate entering the system.

Connection of System Components

Starting at the supply aircraft, connect using a single point nozzle (D-1 type). After connecting the nozzle, perform a locked nozzle check. Connect a 2-inch by 50-foot discharge hose to the nozzle using the sexless dry break fitting. Install a T-fitting to the end of the discharge hose. Connect a 2-inch by 50-foot discharge hose to both remaining ends of the T-fitting. After these lengths of hose, connect a 100-GPM filter/separator. Lay out the remainder of the HTARS into a modified configuration resulting in two refueling points separated by at least 200 feet between points and 300 feet from the C-17. At each refueling point, connect the type nozzle to be used in refueling (CCR or D-1). After making all connections, make sure that all valves in the sexless fittings are in the open position. After opening each valve, manually attempt to disconnect the drybreak connection. If the hardware is assembled properly, the equipment will not disconnect. If it does disconnect, replace the faulty connection.

Grounding and Other Equipment

Drive a grounding rod into the ground 10 feet back from the end of each dispensing hose. Loop the dispensing hose back to the ground rod and hang the nozzle on the ground rod hanger. Connect the clip of the nozzle grounding wire to the ground rod at each point. Place a fire extinguisher, a spill container, and a filled 5-gallon water can at each point. Also place a grounding rod at the filter/separator and connect using the filter/separator grounding wire. Also place a fire extinguisher at the filter/separators.

Operation

Operate the system in compliance with safety procedures in Chapter 2 and the following operation steps:

- The soldier operating the nozzle guides the aircraft into position using the signals described in Chapter 2. Check with the pilot to ensure that all armaments are on SAFE.

- Members of the crew, except the pilot or copilot who may remain at the controls if necessary, should deplane and assist with refueling or man the fire extinguishers.

- Carry the fire extinguisher out to the aircraft and place it within reach of the aircraft fill point.

- The pilot should notify his commander that he will be off the air during refueling. He may monitor his radios during refueling, but never transmit.

- Ground the aircraft.

- Bond the nozzle to the aircraft in one of two ways. Insert the bonding plug into the plug receiver on the aircraft or attach the clip of the nozzle bonding cable to a bare metal part of the aircraft other than the antenna.

- After the nozzle is bonded to the aircraft, remove the dust cap from the nozzle and open the aircraft's fill port.

- Verify that all valves are open.

- Signal to the refueling supervisor using predefined hand signals that point is ready to provide fuel. Open nozzle and refuel. Do not leave the nozzle at any time during the refueling. Stop the flow of fuel if there is any emergency at the refueling point.

- After the receiving aircraft is full, shut off the nozzle. Disconnect nozzle from the aircraft. Replace the cover of the aircraft fill port and put the dust cap back on the nozzle.

- Unplug the nozzle bonding plug and carry the nozzle back to the nozzle hanger.

- After receiving clearance, the aircraft is free to take off.

- Evacuate fuel from the system using the FARE pump and recover the components using the following procedures:
  - •• Close D-1 nozzle.
  - ••Install the FARE pump 10-feet away from the SPR panel.
  - ••Reverse the flow direction of each filter/separator.
  - ••Start pump and run at idle.
  - ••Recover hoses, starting at the refueling point.
  - ••Stop pump and disconnect from the tanker aircraft.

ADVANTAGES/DISADVANTAGES

Advantages

The advantages of the C-17 FARP are listed below.

- The C-17 can deliver bulk fuel to remote areas using small airfields with unimproved runways and little supporting infrastructure.

- The system can be set up and operational quickly.

- The C-17 FARP is useful for special operations.

Disadvantages

The disadvantages of the C-17 FARP are listed below.

- The C-17 aircraft is diverted from other valuable missions to perform FARP operations. The use of other FARP systems may be a more desirable allocation of resources.

- The C-17 requires a 3,000- by 90-foot minimum runway for landing.

- The operation may not be strategically advantageous in consideration of viable alternatives.

- The Army unit operating the FARP is responsible for transportation of personnel and equipment to the FARP site.

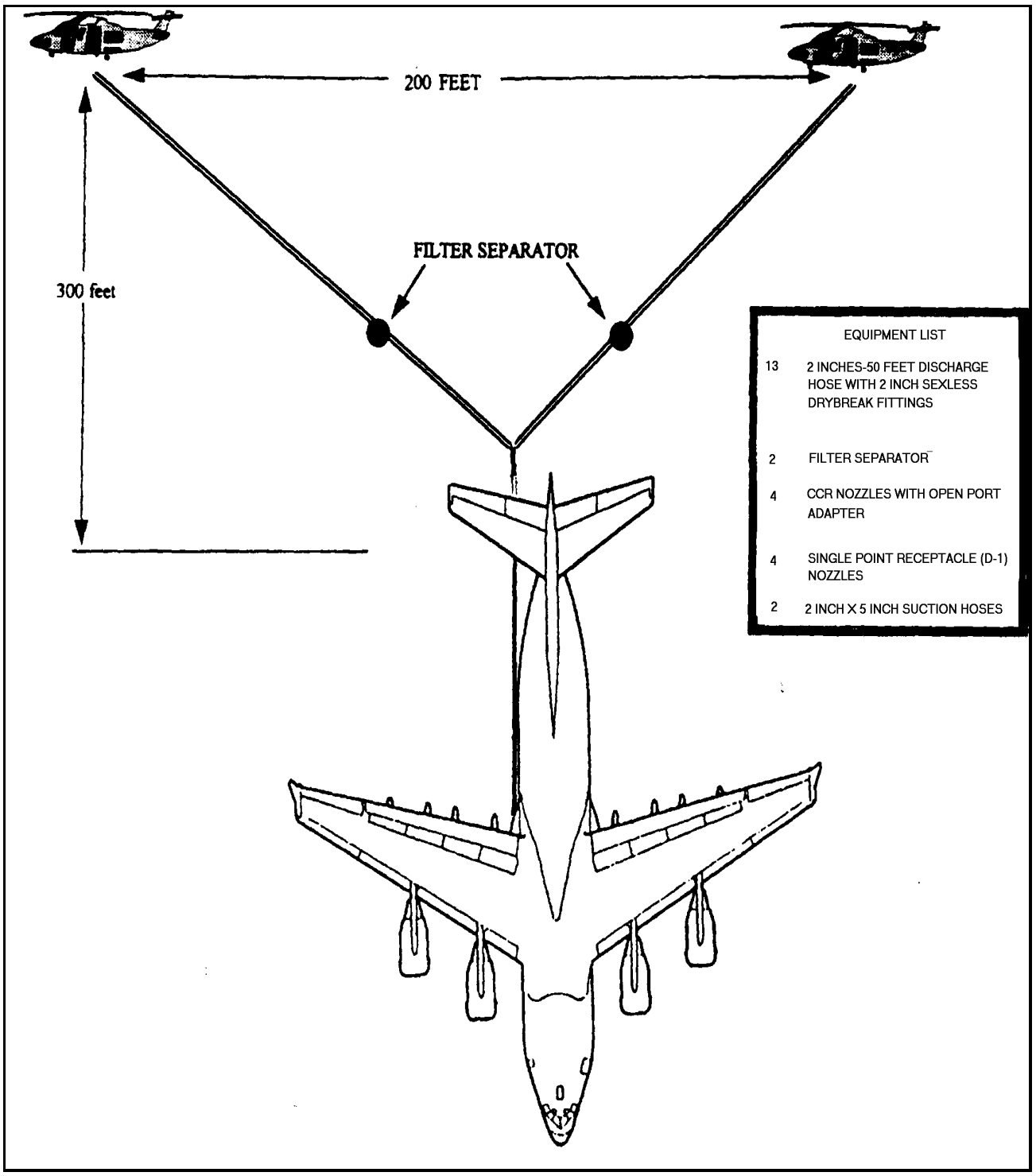


Figure 15-20. HTARS configuration and additonal components for C-17 FARP